THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

No. XXVII. SECOND SERIES. August 1, 1804.

Specification of the Patent granted to William Bicknell, *of the Parish of St. George, Hanover-square, in the County of Middlesex, Hosier, Hatter, and Glover; for a new and improved Method of covering Felt for the making of Caps and Helmets, and for various other useful Purposes.* Dated April 27, 1801.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said William Bicknell do hereby declare that my said invention of a new and improved method of covering felt for making caps, helmets, and other useful purposes, is performed in manner following: First, I take undyed felt, form it to the size and shape required, stiffen the inside with common glue, then block the cap or helmet, and dip it once, or oftener, as occasion may require, into a boiling cauldron or copper, of the following compositions, till the external surface is covered or coated over equally therewith one-eighth of an inch thick, more or less, at pleasure. The said composition is formed of the under-

under-mentioned materials; *viz.* twenty-five pounds of resin, one pound of bees-wax, and one pound of pitch, boiled or simmered together.

After the cap or helmet has been dipped in the said composition, and coated over in manner herein described, and is become nearly cool and dry, flatten or smooth the external surface with any proper tool or machine for that purpose. Afterwards rub the outside surface well with a brush or sponge, dipped into a boiling-hot dye or preparation, made of the following ingredients; *viz.* twelve pounds of logwood, a quarter of a pound of copperas, half a pound of glue, and one pound of lamp-black, boiled together in about eight gallons of water. After this operation is performed, dip the cap or helmet into a cauldron or copper of boiling liquid, compounded of equal quantities of the ley, bees-wax, and ivory-black, the latter being first sifted through a fine sieve. After the last-mentioned operation is performed, and the cap or helmet is become cool, flatten and smooth the surface thereof with any proper tool or machine, in order to unite the different compositions, and give firmness and stability to the same. Lastly, the cap or helmet must be made quite smooth and polished by any proper implement, or by the friction of a turning wheel or lathe rubbed against the external surface. When the cap or helmet is thus finished, it will be completely water-proof, will resist a pretty severe blow or cut from a sabre, be very durable, and may be kept clean and neat for years, with little trouble, by blacking the external surface now and then, as occasion may require, with a common heel or black ball, and polishing it afterwards with a brush, as you would a leather pouch.

In witness whereof, &c.

Specification of the Patent granted to ROBERT ATKINS, *of Fenchurch-street, in the City of London, Mathematical Instrument-maker; for Improvements in the Construction of Hydrometers for ascertaining the Strength of Spirituous Liquors; and of a sliding Rule of Correction for Temperature to the Hydrometer.*

Dated October 31, 1803.

TO all to whom these presents shall come, &c. Now KNOW YE, that I the said Robert Atkins, in compliance with the said proviso in the said letters patent, do hereby declare that my said inventions and improvements in the hydrometer and sliding rule of correction for temperature are described and explained as follows: The hydrometer, with the following improvements adapted to it, may be made of any dimensions, and of any convenient form, consisting of a hollow metallic bulb, with a prismatical stem, consisting of three sides, which are graduated with divisions that indicate specific gravities or degrees of strength of spirituous liquors over and under proof; and it has a shank, proceeding from the opposite end of the bulb, to which weights are to be affixed, as is usual in other hydrometers. On one of the faces of this prismatical stem, which I enamel, gild, silver, or varnish, I engrave or paint a series of divisions, representing *per* centages or degrees of strength over proof expressed in commercial terms; the line which indicates proof being at the lower end of the stem near the bulb marked P, or Pr. *(proof)*, and the *per* centages over proof are marked in successive graduations as high as the length of the stem will admit. Another face of the stem, which may be enameled or coloured differently from the

 last-

last-mentioned, has a series of divisions on it expressing *per* centages or degrees of strength under proof; the proof-mark being at the superior extremity of the stem, and the graduations proceeding in an inverse direction to those on the over-proof side of it: the notation may also be expressed in Roman characters on this side, or *vice versa, so as the more effectually to characterise or distinguish the side of the stem which is representative of the degrees of strength over proof from that which expresses the degrees under proof.*

The degree of strength of any compound of water and alcohol may be expressed in various ways. The mode above mentioned is that which has been in common use of *per centages* or gallons to the hundred over or under proof, which is an arbitrary term, adopted from custom, and consequently well known. I have, however, adapted another mode of expression *to this hydrometer*, which may enable the excise officer and merchant to ascertain with greater facility the quantity of proof-spirit which several different quantities of an over-proof spirit may contain, or, in other words, it will facilitate the operation of casting up the over-proofs (*as the trade call it*) on any given quantity. According to this method, the degrees of strength are expressed in ten *per cents.* over or under proof, and the fractional parts of ten, halves and quarters; *viz.* ten *per cent.* over or under proof, ten and a quarter, ten and a half, three-quarters, and so on with twenty *and thirty*, &c. This being understood, the following notation will be easily comprehended, the letters O or U meaning over or under proof. O $\frac{1}{4}$, O $\frac{1}{2}$, O $\frac{3}{4}$, O 10, O $10\frac{1}{4}$, O $10\frac{1}{2}$, O $10\frac{3}{4}$, O 20, O $20\frac{1}{4}$, O $20\frac{1}{2}$, O $20\frac{3}{4}$, O 30, O $30\frac{1}{4}$, &c. or U $\frac{1}{4}$, U $\frac{1}{2}$, U $\frac{3}{4}$, U 10, U $10\frac{1}{4}$, U $10\frac{1}{2}$, U $10\frac{3}{4}$, U 20, U $20\frac{1}{4}$, U $20\frac{1}{2}$, U $20\frac{3}{4}$, U 30, U $\frac{3}{4}$, &c. &c. or, instead of 10, 20, 30, &c. it may

may be expressed more simply by units, thus, 1, 2, 3, &c. *over or under proof*.

In order to adapt the instrument, constructed in this way, *or graduated in this or any other manner*, to the various degrees of heat at which spirituous liquors are found to be in the ordinary states of the atmosphere, I adjust a series of thermometer weights to various temperatures, between 80 degrees and 30 of Fahrenheit's scale, which I make of different *geometrical* figures, that they may be more easily distinguished from each other, three of them triangular, three *rectangular* or square, three pentagonal, and three circular, and three more of some other figure if necessary; *twelve however are sufficient, each differing three degrees in temperature from the one preceding it*; each set I number 1, 2, 3. The form and number of each of these weights I engrave on the thermometer scale opposite to the temperature to which each is respectively adjusted; against 80 degrees on the thermometer, or some other degree, for instance, I engrave or mark the character and number of the lightest thermometer weight, thus, 80 — △ 1; the next below it is represented thus, △ 2, &c. so that the character, and number which the quicksilver in the thermometer may stand opposte to will shew the character and number of the weight to be applied in order to discover the strength of any sample of spirituous liquor under examination. These weights may be either applied to a wire at the top of the stem, or pass over it and rest on the bulb, or be adapted to the lower end of the shank, or in any other way the artist may chuse to adopt.

If the hydrometer be immersed in any spirituous liquor which is over proof, and loaded with the weight that is indicated by its temperature, the divisions on the side of the

the stem, which I mark O. P. or over proof, with the proof mark at the bottom of it, will indicate the various degrees of strength of such kind of spirits; but if they are under proof, a small weight, which I mark U. P. or under proof, must be applied to the instrument, which may be made either to screw or slide on to the bottom of the shank; in which case the under-proof side of the stem, with the proof mark at the top of it, will indicate all such degrees of strength.

This instrument therefore, with one weight for under proofs, and the thermometer weights, *or compensation weights for temperatnre*, already described, will indicate immediately on inspection the degrees of strength of any spirituous liquor in which it may be immersed, that is met with in the market, and each division or *per* centage is perfectly distinct and legible.

For the purpose, however, of rendering this instrument as complete as possible for the distiller and rectifier, as well as for the merchant and the officers of the revenue, I graduate the third side or face of the stem with a series of equal parts, which may be marked either numerically or alphabetically, and which refer to the sliding rule for correction of temperature. These graduations may consist of any number that can be distinctly seen. I likewise adapt three weights to this face of the stem and the sliding rule, and mark them in the order of their value, "Rule 1," Rule 2," "Rule 3;" and, farther, distinguish them from the *thermometer weights*, or those which refer to the other sides of the stem, by making them of different geometrical figures.

The sliding rule next to be described is similar to that invented by the late Matthew Quin, and which is well known. It is constructed to indicate the relative value or strength

strength of any sample of spirituous liquor at some standard temperature, whatever it may be at the time of *its* examination *by the hydrometer*. This standard temperature may be any degree which the hydrometer-maker may chuse to adopt until it shall be settled by authority of parliament, the specific gravity of water and that of proof spirit being assumed.

The series of divisions on the sliding rule to which the hydrometer refers, when it is used without any of the detached *thermometer* weights being applied to it, *and the weight marked "over proofs" disengaged from the bottom of the shank*, and which series of divisions are equal in number to those on the face of the stem last described, I mark "without weights" *or* "*alcohols*," by which I mean, that if the instrument *thus situated*, on being immersed in any spirituous liquor, should subside in it so far, as that its surface will cut some division on the stem, the reference to the rule for ascertaing the specific gravity and strength, must be to the series of divisions on it marked "without weights" *or* "*alcohols*." For the inferior degrees of strength, it is necessary to load the instrument with one of the rule weights, which I mark Rule 1, 2, or 3, *or "over-proofs" and "under-proofs*," the description and number of which I mark on the rule, opposite to the series of divisions to which each respectively refers: these series I distinguish from each other on the rule by lines perpendicular to the order of their arrangement, *in the following manner:*

9. 8. 7. 6. 5. 4. 3. 2. 1. 0. 9. 8. 7. 6. 5. 4. 3. 2. 1. 0. 9. 8. 7. 6. 5. 4. 3. 2. &c.

Rule Weight No. 2.	Rule Weight No. 1.	Without Weight,
or Under Proof Weight.	*or Over Proof Weight.*	*or Alcohols.*

Or thus: L K I H G F E D C B A O Z Y X W V U T S R Q, &c. &c.

Rule Weight No. 2.	Rule Weight No. 1.
or Under Proof Weight.	*or Over Proof Weight.*

These numerical or alphabetical characters are common to other hydrometer rules; but I distinguish each series on the rule from the preceding or succeeding ones, by separating them from each other by the lines as described, and by describing on my rule the weight to which each series respectively belongs.

It

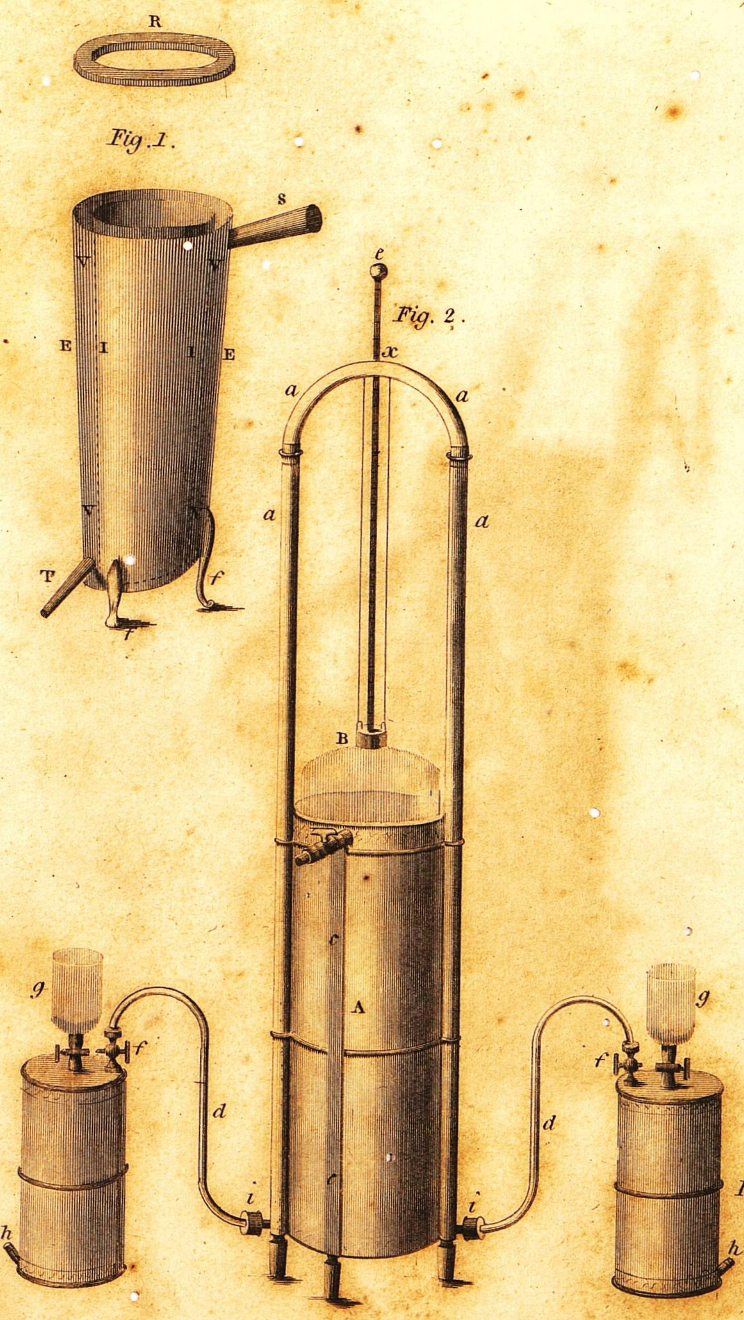


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

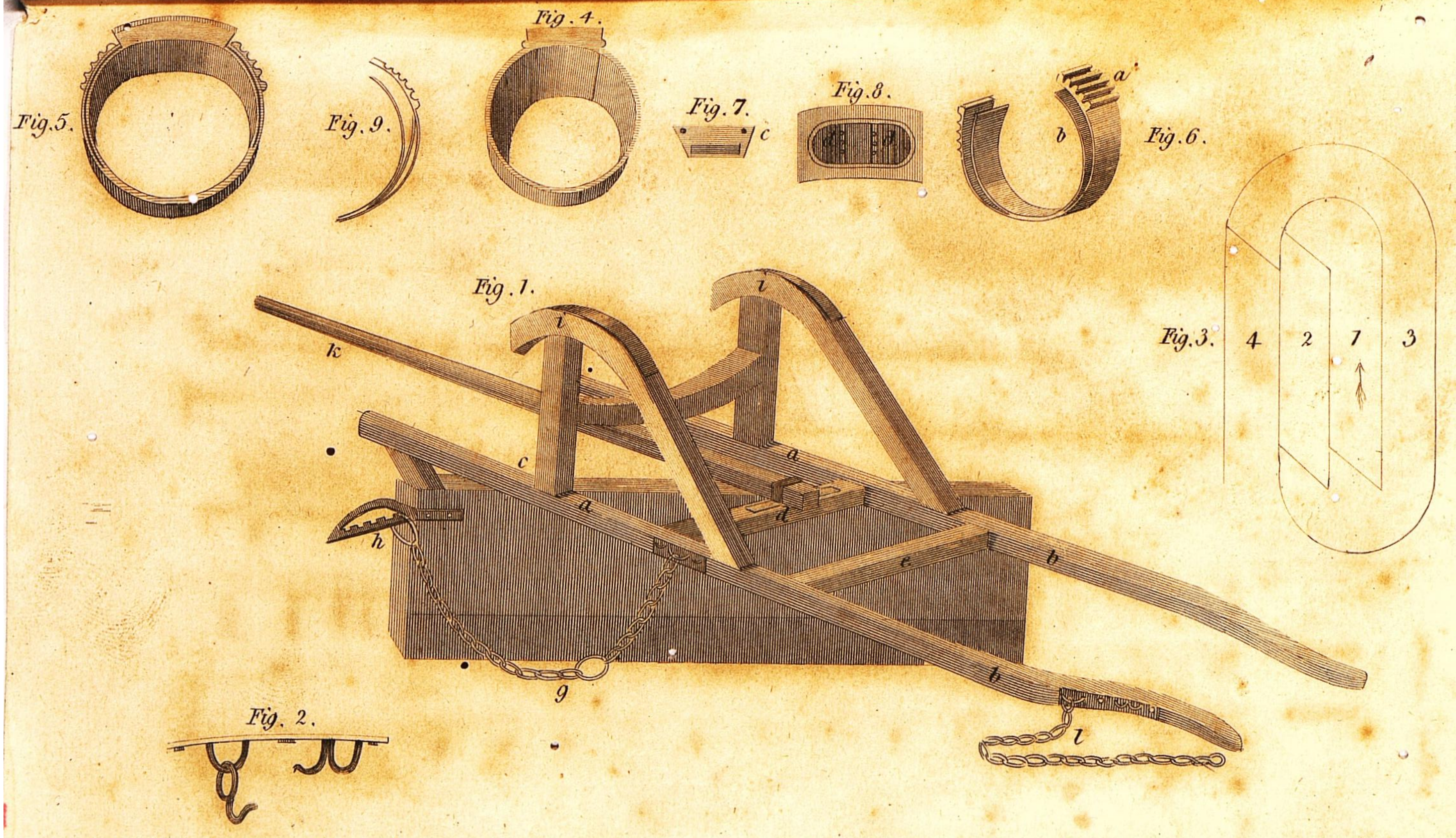


Fig.5.
Fig.9.
Fig.4.
Fig.7.
c
Fig.8.
a
b
Fig.6.
Fig.3.
4
2
7
3
Fig.1.
i
i
k
c
a
a
d
h
e
b
b
g
l
Fig. 2.

Fig. 1.

Fig. 2.

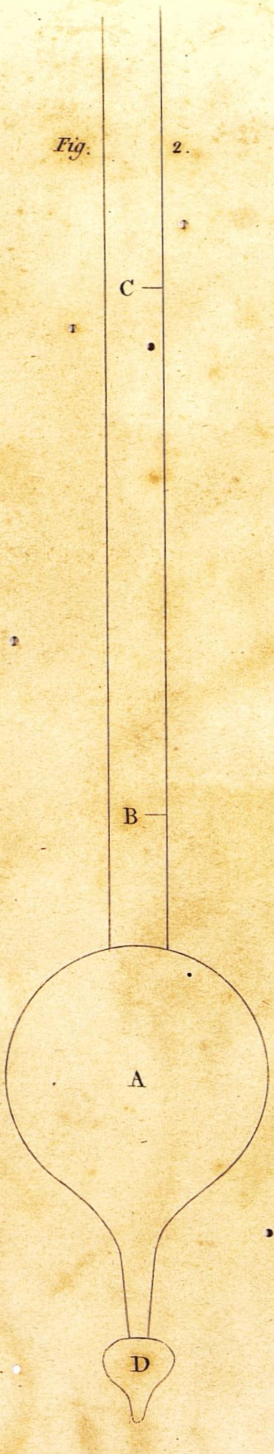
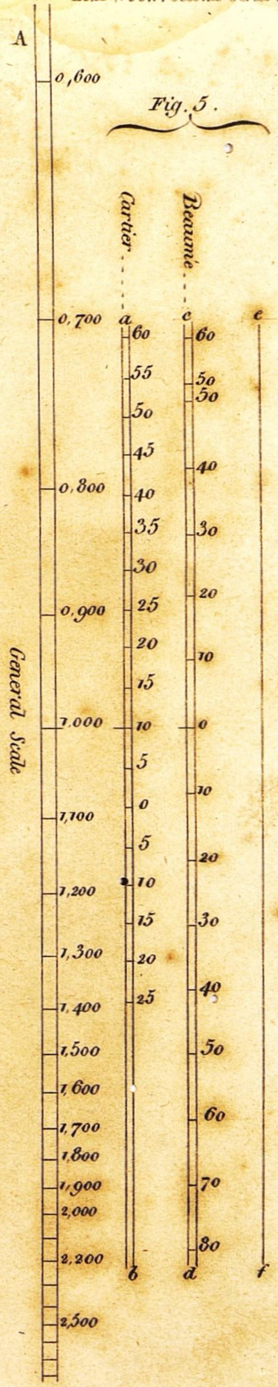


Fig. 5.



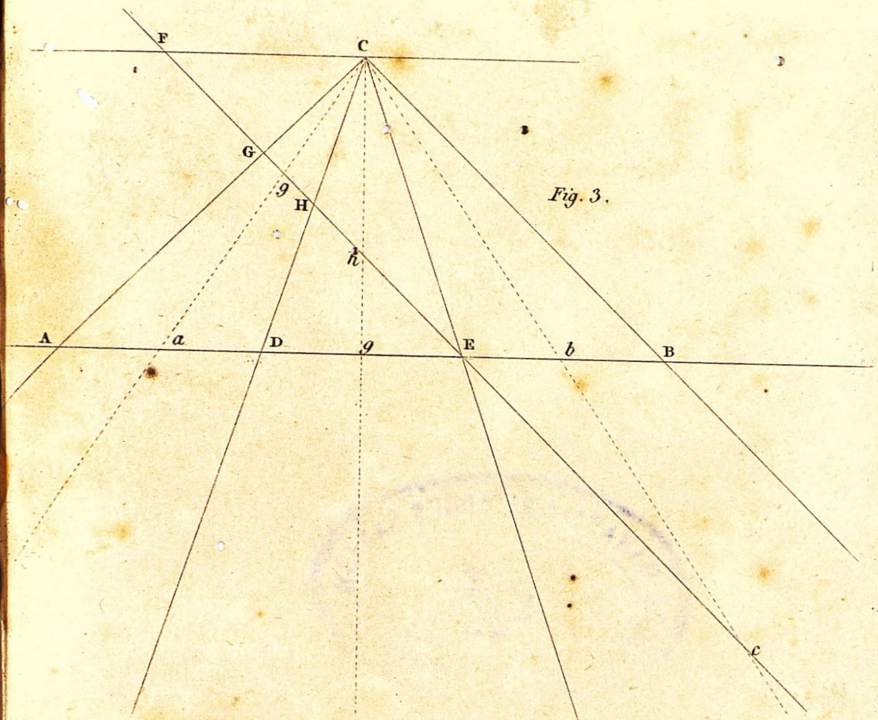

F
C
G
g
H
h
A
a
D
g
E
b
B
c

Fig. 3.

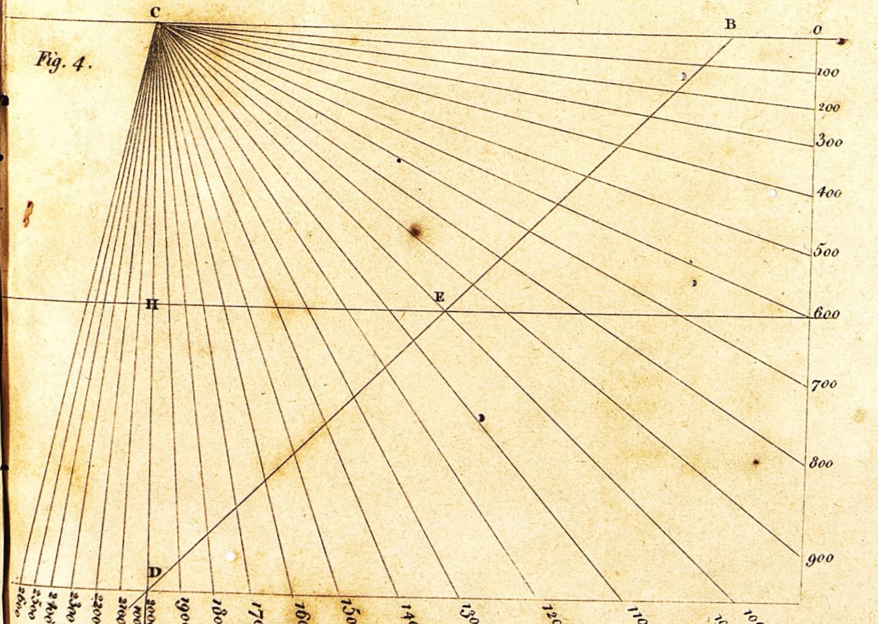

C
B
0
100
200
300
400
500
H
E
600
700
800
900
D
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000

Fig. 4.

It can only be necessary to observe, in order to render my method perfectly intelligible, that if the divisions on the hydrometer are marked with numerical figures, those must be used on the sliding rule; but, when I mark the divisions on the hydrometer with the letters of the alphabet, I do so likewise with respect to the rule. The different weights described in this specification are adjusted by experiments in spirituous liquors, whose specific gravity, temperature, and degrees of strength, have been previously ascertained by other well-known methods, *or by arithmetical computation.*

I likewise construct the sliding rule so as to fold or double it up into one half its length when open. I divide the rule into two equal lengths, and connect them together by joints on each side; when the rule is extended or open, the sliders, which are uniformly of the same dimensions throughout their whole length, may be easily moved or set to any part of the rule; but when it is to be folded up, they must be returned to their proper situation on each side of the joint. By this contrivance I unite the advantages of large and perspicuous graduations with those of portability.

The instruments and sliding rule as above described combine every advantages which other hydrometers are supposed individually to possess, and by means of the various inventions and improvements that I have adapted to them, and explained in this specification, their utility to the public will, it is presumed, be rendered sufficiently manifest to every capacity; but more particularly to those who are in the habit of using such instruments daily, and who are consequently most competent to decide on their real merits or demerits. In witness whereof, &c.

N. B. The passages in italic are not in the office copy, but have been interpolated by the patentee to render the specification more explicit.

Specification of the Patent granted to TIMOTHY BENTLEY, *of Lockwood, in the Parish of Aldmondbury, in the County of York, Common Brewer; for a Method of seasoning new Casks and purifying musty ones.*

Dated June 19, 1804.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Timothy Bentley do declare that my said invention is performed in the following manner; that is to say: Having created a quantity of steam, by means of a boiler, the same is conducted, by a pipe and small branching tubes, into the casks, placed upon the end, or otherwise, a few inches below the upper head, or at the bung-hole; the tap-hole, or other aperture, being at the lowest part, in order that the foul particles may drain off along with the water which the steam occasions while passing through the casks. When they are cleared, the steam from the boiler is to be couveyed through a pipe into a cylinder, or any other air-tight vessel, in which is inclosed another vessel, open at the top, and raised from the bottom of the outer vessel, so as to allow the steam free access to all parts thereof. This inner vessel is to contain a mixture of small raw wort and spent hops, either with or without stale beer or beer grounds, or beer grounds only, which, by means of the steam from the boiler, must be raised to a state of ebullition. When the steam from the boiler is sufficiently incorporated with that arising from the ingredients in the inner vessel, it is to be conveyed into the casks, in like manner as the steam from the boiler, before described. Or the small raw wort and spent hops, with or without stale beer or

beer

beer grounds, or beer grounds only, may be brought to a state of ebullition by being placed in the outer vessel, and the steam conveyed thereto by proper tubes. Or the mixture may be placed in the boiler, and the steam thence conveyed into the casks, as before described.

The above applications will answer for the brewers of ale, beer, or porter. For vinegar brewers, the grounds or sediments of vinegar are to be used. For distillers, rectifiers, brandy merchants, &c. the rinsing of spirit casks. For cyder and sweet makers, raisin stalks, or the lees and refuse of their respective liquids.

These are a few specimens of suitable ingredients for perfectly seasoning casks, after the application of steam has expelled the pernicious qualities of new wood, and the nauseous foulness of musty ones: other ingredients might answer the purpose, but the above are the least expensive, and probably the best; this, however, may be left to the judgment or fancy of the operator, as the merit of this discovery does not essentially depend on either the peculiar sort of ingredients to be used, or the mechanical form of the necessary apparatus, nor the kind of materials which compose it, but on the application of steam, separate from, or which is or shall be intermixed and incorporated with, the steam arising from any mixture of ingredients, the most suitable to the nature of each respective branch of trade to which the invention is or may be applicable.

In witness whereof, &c.

Specification of the Patent granted to FREDERICK ALBERT WINSOR, *of Cheapside, London, Merchant; for an improved Oven, Stove, or Apparatus, for the Purpose of extracting Air, Oil, Pitch, Tar, and Acids, from, and reducing into, Coke and Charcoal, all Kinds of Fuel, and which is also applicable to various other useful Purposes*.*

Dated May 18, 1804.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Frederick Albert Winsor do hereby describe and ascertain the nature of my said invention, and the manner in which the same is to be performed, as follows; that is to say; A metal, brick, or earthen stove, oven, retort, or vessel, so constructed as to reduce, by means of fire and heat, all raw fuel, of any kind, into coke and charcoal, without any or little consumption of the fuel; by which operation, the smoke, being extracted from all raw fuel, is thus conducted through cold air or water into a condenser, which after being sufficiently cooled and purified, undergoes a natural chemical resolution into tar, pitch, oil, acid, ammonia, and inflammable gas or air. Thus, by the above means of carbonizing raw fuel with heat instead of burning it, the whole weight is preserved, and resolved into the said products. Any metal, brick, or earthen stove, oven, retort, or vessel, constructed as above, may dry, melt, heat, distill, or boil, any pot, pan, or vessel, in refineries, breweries, distilleries, smelteries, forges, steam-engines, or any other purpose whatever where much fuel is consumed;

* The author of this specification being a foreigner, our readers will make allowances for some inaccuracies of expression.

which,

which, to save and preserve, the above principle of carbonization, can be applied, first, to heat any vessel, &c. by the construction of such a carbonizing utensil; secondly, to heat another vessel, &c. by the hot smoke extracted from raw fuel; thirdly, to heat a third vessel, &c. by the inflammable air or gas made from smoke; and, fourthly, to heat any fourth vessel, &c. with the coke or charcoal saved by this principle of carbonization; and also for applying the charcoal in manufacturing gunpowder as containing much more strength, pitch, and tar, so produced, retaining all its oily virtues, (lost by evaporation in all other methods,) being superior in quality, may be used and applied to preserve vessels, buildings, railings, pailings and other things exposed to the weather, against the effects of air and water. The wood or vegetable acid or liquid may be used in manufacturing alum, vitriol, copperas, and white-lead, and in calico-printing, dyeing, and tanning. The sails of ships prepared by this acid will be much increased in their utility and durability. Ammonia being a powerful pungent liquid, may be also used and applied in tanning, printing, dyeing, and fixing colours, or staining. It may also be crystallized into sal ammoniac, camphire, &c. Both the wood acids and coal ammoniac, mixed with some of its own tar, &c. will prevent timber, &c from putrifying, rotting, and getting worm-fretted; preserve all vessels, buildings, &c. already affected, and even cure timber, buildings, &c. from the dry-rot, and prevent any conflagration from fire, by reason of the inflammable gas being extracted.

This wood acid and ammonia will farther operate as strong preventives against all foul pestilential infections of the air, from its powerful odour and perforating quality. The inflammable gas or air being purified from that carbon, so pernicious to respiration and dwellings, may

may be led and conducted in a cold state through tubes of silk, paper, earth, wood, or metal, to any distance in houses, rooms, gardens, places, parks, and streets, to produce light and heat. This principle of carbonization, and preserving inflammable air from raw and refined smoke, is applicable to all public and private illuminations, light-houses, telegraphs, and making signals on steeples, halls, towns, mountains, houses, ships, and sea-coasts.

The above apparatus and principle of carbonization is applicable to mechanics, hydraulics, or any other purpose for increasing and multiplying force and power whatever.

In witness whereof, &c.

Description of a new Kind of Refrigeratory or Condenser, to be used, instead of a Worm, in the Distillation of Spirituous Liquors. Invented by Baron P. N. VON GEDDA, *and used in the Royal Distilleries of Sweden.*

With an Engraving.

Communicated by a Correspondent.

THE worm usually employed for condensing the vapours, in the distillation of spirituous liquors, is of difficult workmanship, is very dear, and cannot be tinned on the inside; it is also subject to get out of repair, on account of the many pieces of which it consists, and the many solderings required to join these different pieces, sometimes ten or twelve in number, according to the length of the worm.

If we consider the true principles of natural philosophy, the condensation of the vapour depends on the largeness of the cooling surface, not on the length, or number of spiral

spiral turns, of the worm, otherwise than by procuring an augmentation of surface, by an increase of length. It has been found by experience, that a short, somewhat flat vessel, of only two yards in length, but of nine square feet surface, has, in the same circumstances, or with the same quantity of cold water, at the same temperature, a greater cooling power, than a worm of five spiral turns, and six yards length in the whole, but of only seven square feet cooling surface.

According to this principle, the new refrigeratory or condenser, is of a form that allows the greatest cooling surface that can conveniently be given in the round tub, or water-reservoir, in which it is placed; it consists of two concentric cylinders, or rather inverted truncated cones, one within the other, but leaving a small interval, or void space, which space is closed at the upper as well as lower end; in this interval, or void space, the condensation of the vapour is effected, by the cold water which surrounds the outer and fills the inner cone; by this form, a very large and double cooling surface is obtained, in a small and convenient space.

But this large surface is not the only advantage of this condenser; the interval or narrow space between the cones is three times larger at the upper than at the lower end; besides, the upper diameter of the outer cone is to the lower as three to two. By this construction, the vacant space between the cones, in which the condensation of the vapours is performed, is more than twice, and almost three times, as great at the upper half of the condenser as at the lower; the consequence of which is, that the vapour, being lighter than the air, will remain at the upper end of the condenser, and there deposit all, or at least the greatest part of its heat; so that only the upper part of the water in the tub or reservoir will be heated,

heated, and the lower part remain cold, particularly if, as is most advantageous, fresh cold water comes in at the bottom of the tub, while the hot water runs off at the top.

It has been found by experience, that if the tub or reservoir contains four or five times as much as the still, very little or no fresh water is necessary to be added, during the working off the first still; and afterwards much less is necessary than with the worm.

The principles upon which the cooling surface, as well as the capacity of this condenser, are determined, are founded on experience. It has been found, that for a still of two feet in diameter, containing about thirty or thirty-two gallons, a condenser of nine, or at most of ten square feet cooling surface is sufficient; and as evaporation, or the generation of vapours, is in proportion to the surface, when heat and other circumstances are the same, the cooling surface of condensers for larger or smaller stills must be in the above-mentioned proportion, according to the square of the diameter of the stills; so that a still of four feet diameter requires a condenser of thirty-six or forty square feet of cooling surface, and a still of five feet diameter (the largest used in the royal distilleries of Sweden) fifty-four or sixty square feet of cooling surface. The capacity of the condenser, or the void space between the cones, is regulated upon the same principle of the square of the diameter of the stills, giving a capacity of six or seven gallons to a condenser for a still of two feet diameter, and consequently of thirty-six or forty-two gallons for a still of five feet diameter, rather more than less.

If E signifies the upper diameter of the exterior cone, and *e* the lower diameter; I the upper diameter of the interior cone, and *i* its lower diameter; H the height

or

or length of the cones, which is equal in both, and three times the upper diameter of the exterior cone; then $\frac{E+e}{2}$ will be the diameter of a cylinder x, which, when of equal height with the cone, will have the same capacity; $\frac{I+i}{2}$ will, in the same manner, give the diameter of a cylinder y of the same capacity as the interior cone; and $x-y$, or the capacity of the interior cylinder substracted from that of the exterior, will give the capacity of the condenser, or of the vacant space between the cones, where the condensation of the vapours is effected.

The following are the proportions of the largest condensers that have been made for the royal distilleries of Sweden, and for stills of six hundred gallons, whose diameters are about four and a half to five feet, Swedish measure *.

E 33 to 34 inches; e 21 inches.

I 27 inches; i 19 inches.

H 84 inches, or 7 feet.

The distance between the two cones at the upper end, 3 to 3½ inches; and at the lower end only 1 inch. The cooling surface of these condensers are from 80 to 84 square feet; and the capacity, 76 to 80 Swedish kannes, (from 50 or 53 gallons.)

These condensers are not exactly after the proportion given before, or 9 to 10 square feet for a still of two feet diameter; both the surface and capacity are larger, a great exactness in that respect not being necessary; and it

* The Sweedish foot is to the English, as eleven to twelve, or as one hundred to one hundred and nine; and a foot is divided into twelve inches, each inch into eight pa[illegible]s; a Swedish kanne is to an English gallon, as one hundred to one hundred and forty four, or nearly as two to three.

is better to make both the surface and capacity somewhat larger, rather than smaller. Some regard must also be had to the size of the copper plates, that no unnecessary solderings on one hand, or unnecessary clippings on the other, may exist.

The price of such a large condenser is not half that of a corresponding worm, of eleven spiral turns, and near seventy feet length in the whole. The weight of the condenser is also only half that of the worm, as it can be made much thinner than the worm, and the workmanship is infinitely less tedious and difficult than that of the worm.

It is almost unnecessary to say, that the distance between the cones is lessened in the smaller condensers, and that, in one for a still of two feet diameter, this distance, at the upper end, is not above 1 or $1\frac{1}{2}$ inch; and at the lower end, $\frac{1}{3}$ of an inch, or $\frac{1}{2}$ an inch; or $E-I=2$ or $2\frac{1}{2}$ inches, and $e-i=\frac{2}{3}$ or 1 inch. The water in the tub or reservoir must stand $1\frac{1}{2}$ or 2 feet above the condenser.

It has been objected, by some persons, before these condensers were tried, that the water in the inner cone would soon be overheated, and serve to little purpose; but experience, as well as theory, has shewn the contrary. Hot water is lighter than cold water; if the water in the inner cone grows hotter than that which surrounds the outer one, it must necessarily float up to the top of the tub, and be replaced with colder water, from the outside and bottom, there being a free communication; the temperature of the water will therefore be the same, at the same height, in the inner cone as at the outside.

RE-

REFERENCES to Plate VIII. Fig. 1.

E, the exterior cone.

I, the interior one.

V, the void space, or interval between the cones.

R, a flat ring to be soldered on the top, the bottom is closed by similar means.

S, the pipe that brings the vapours into the condenser.

T, the lower pipe, where the condensed liquor runs off.

ff, two of the feet on which the condenser stands in the tub or water reservoir.

Description of an improved Gazometer. Invented by Mr. FREDEICK ACCUM, *of Compton-street, Soho.*

With an Engraving.

Communicated by the Author.

THE name of *gazometer* was first given by M. Lavoisier to an apparatus which he invented for the purpose of measuring and transferring gases. The instrument, however, was too complicated and costly to be admitted into the laboratory of the ordinary chemist, nor would it have long remained applicable to the advanced state of the science. The apparatus promising however to become an instrument of great utility to the philosophical chemist, on account of the variety of purposes to which it might be applicable, men of genius have endeavoured to simplify it as much as possible. The only apparatus of this kind with which I am acquainted was constructed by myself, and described in my System of Practical Chemistry, vol. II. p. 354. Since that time, I have however so materially improved the instrument, that I flatter myself a description of it will be acceptable to your readers.

Fig. 2, (Plate VIII.) represents a perspective view of the gazometer. It consists of an exterior cylindrical vessel A, made of japanned iron or copper, and an interior glass cylindrical vessel B. The outer metallic vessel is furnished with a stop-cock, soldered to the upper rim of the vessel. From this cock a tube *c c* runs down the outside of the vessel A, and passes under its bottom, where it branches out and communicates with the tubes *d d* of the air-holders, Figs. 3 and 4. In the centre of the vessel A this tube branches upwards, and thus a communication is made from the stop-cock of the exterior vessel, A, the air-holders Figs. 3 and 4, and the glass bell B, which is suspended in the vessel A by means of weights and pulleys, contained in the bend, arch, and tubes *a a a a*. To the top of this glass bell B in fixed a metallic cap, into which is screwed a graduated rod *e*, which expresses, by the coincidence of any of its divisions with the aperture *x*, the capacity of the emerged part of the glass bell, and consequently measures the quantity of gas contained in it. In using this gazometer, the exterior japanned vessel A must be filled with water until it is on a level with the aperture of the tube in its centre. The glass vessel or bell B is then to be depressed (the stop-cock in front of the vessel A being open) till the coincidence of the Zero point of the graduated rod *e* with the aperture *x* indicates its total emersion. The stop-cock in front of the vessel A is then to be shut. This being done, a communication is made between the glass bell B, Fig. 2, and the two air-holders Figs. 3 and 4, (which shall be described hereafter,) by means of the tubes *d d* and *c c*, as well as the opening of the two stop-cocks *f f* affixed to the air-holders Figs. 3 and 4. The gas contained in the air-holders, Figs. 3 and 4, may thus be transferred into the bell glass by merely pouring water into

into the bell-shaped vessels *g g*, furnished with stop-cocks affixed to the air-holders. A given quantity of water, when thus introduced in either of the air-holders, will of course displace an equal quantity of air contained in them; this will pass, by means of the tubes *d d* and *c c*, into the bell B, which, as it becomes filled, will ascend by the pressure of the introduced gas, and from this it may be again easily transferred in any quantity, and at any time, by means of the stop-cock in front of the exterior vessel, taking care that the other stop-cocks are respectively shut. For breathing gas from this gazometer, a glass tube, furnished with an ivory mouth-piece, may be adapted to the stop-cock in front of the exterior vessel A, and the quantity of gas breathed will be measured by the graduated tube *e*.

In order to understand the construction of the air-holder, Figs. 3 or 4, (which was invented by Watts,) it must be observed, that this cylindrical vessel is made of copper or iron, japanned within and without; in the centre of it is a metallic tube, descending within nearly half an inch of the bottom of the vessel, or below the small projecting tube *h*. This tube terminates in a stop-cock connected to the glass bell *g*, which, having connected to its neck a cap with a female screw working in the male screw of the stop-cock of the air-holder, may therefore be removed at pleasure.

To charge this air-holder with any gazeous fluid, close the small projecting tube *h* carefully with a cork, and shut the stop-cock *f*. Having done this, fill the air-holder completely by pouring water into the funnel *g*. This being done, close the stop-cock of the glass bell, and then withdraw the cork which closed the aperture of the tube *h*. It is now obvious that no water can run out till some air be introduced to expel it. When it is therefore

fore wished to be filled, let the neck of the retort, or gas bottle, from which the air proceeds, be loosely inserted into the orifice of the tube *h*; the gas as it is disengaged will expel the water by the same aperture till the vessel be completely filled with the gas. If the orifice of the tube *h* be now corked, the gas may be preserved for any length of time; or if it be wished to serve for filling the gazometer, let water be poured into the bell, and proceed as directed before. In order to join the air-holders Figs. 3 and 4 conveniently to the gazometer, an accommodating socket *i* is interposed between the body of the gazometer and the flexible metallic tube *d*, with screws, to make the junctures of the vessels air-tight with facility.

Description of a Machine for clearing Turnpike and other Roads from Mud. Invented by Dr. JOHN WINTERBOTTOM, *of Newbury, in Berkshire.*

With an Engraving.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Silver Medal was voted by the Society to Dr. WINTERBOTTOM *for this Communication.*

IN a description of this machine, I shall briefly notice the five principal parts of which it is composed; the frame, the scraper, the chain, the sledge, and the pole.

The frame (Fig. 1, Plate IX.) consists of two pieces of timber *a a*, which at one extremity are formed into a pair of shafts *b b*, and at the other are strongly united by three transverse pieces *c d e*.

The

The scraper *f* is placed under this frame work, in an oblique direction, at an angle of 30 degrees, between two of the transverse pieces *c d*, and consequently forms an angle of 150 degrees with the line of draught. By this position of the scraper, the machine, when used, actually clears itself from the mud as fast as it is collected, and removes it into a heap on one side, after the manner of a plough.

The chain *g* is connected with a piece of iron-work *h*, which projects from the lower end of the scraper; for here additional power is required, as the whole body of the mud, which has been collected, must pass off by this extremity. Some advantage has also been gained by making this end of the scraper shorter than the other.

The sledge *i i* is constructed upon the upper part of the frame, that by inverting the machine it can be transported without injury to the scraper, over the most rough and stony roads or pavements, to those places where its use is particularly required.

The pole *k*, which is moveable, serves the purpose of a rudder, that when the machine happens to be forced by any great weight of mud, or solid body of earth, &c. from its proper direction, it can be easily restored to its former position; and it may also be observed, that the moderate pressure of the hand upon the pole tends to make the machine steady, and therefore causes it to work to more advantage. The plates in front of the scraper and upon the sledge are made of cast iron.

Operation.

For the operation of the machine, two men and four horses are required; one man to drive the horses and another to take the management of the pole and the direction of the labour to be performed. The horses are to be

be worked double, as commonly practised, two being employed to draw by the shafts, and two by the chain above described. But the manner of using the machine will be best understood by reference to the engraving, Fig. 3, Plate IX.

The first progress of the machine marked No. 1, commencing from the arrow mark, will remove the mud in a line to the right; the first return, No. 2 will remove another part of it to the left. The second progress, No. 3 will take up what was left by No. 1 besides the quantity which is upon the space now to be passed over, and will remove it all to the right. The second return No. 4, will operate in a similar manner with regard to No. 2, and remove that to the left. Thus, by four lengths, more than twenty feet wide of a road can be cleared; and this has been frequently performed in the presence of several persons. The number of lengths can be increased at pleasure, according to the width of the road.

In the neighbourhood of London, where there is incessant travelling, it would be adviseable to use two machines at the same time, one immediately following the other, as in No. 1 and 3, which will leave a space sufficiently wide for the largest carriage to pass, without disturbing the mud already scraped up.

There is one advantage in the operation of this machine worthy of being noticed, which is, that by the use of it the road is made more even and smooth, the small holes being filled up by the more solid parts of the mud; whereas, when roads are scraped in the usual way, by hand, all the irregularities are increased, and become the future deposits of water; and it is universally known that these puddles, as they are called, are the chief cause of the destruction of roads.

It

It has been observed, that stones are sometimes forced up by the machine; but it appears to be those only, which project in such a degree as to be dangerous to the traveller, and which require to be broken for the more effectual mending of the road.

I can say nothing concerning the effect of the machine upon dusty roads, having had no opportunity of trying it at that season of the year. When, indeed, the roads are watered, as about London, there is no doubt but a great quantity of that dirt may be removed, which in a few hours of scorching sun would again be converted into a body of dust.

If it should be objected, that the machine is too large, and that a smaller one, which might pass over half the space of ground that this does, and might be worked by two horses, would be better; I must beg leave to answer, that, in my opinion, with a less one there would be much labour to little purpose; because this machine, which passes over a space of about six feet and a half, will not, in some places, when the roads are very wet and very deep, leave more than three feet clear, the mud on each side falling in and filling up, to a considerable extent, the space already passed over; it must therefore be obvious, that, under similar circumstances, the track of a smaller one would almost instantly be obliterated.

I can mention, with some pleasure, that several gentlemen acting as commissioners of the roads, have honoured me with their attendance during various experiments; and having witnessed the very powerful effects of the machine, they have given it their public approbation at one of their monthly meetings, when the following entry was made in their minute book.

 "At

"At a meeting of Trustees of the London and Bath roads, held at the Globe Inn, Newbury, on Monday, the 21st of February, 1803; present James Croft, Esquire, Frederick Cousland, Esquire, Reverend Thomast Best, Mr. Richard Bayley, Mr. Thomas Clark, Mr. John Baily, Mr. Joseph Tanner, Mr. Thomas Pocock.

"Resolved, that the machine invented by Dr. Winterbottom for scraping off mud from turnpike roads will be of public utility, and save considerable expense of labour."

After this public testimony in its favour, I might perhaps be excused from producing the certificates of a few individuals; it will, notwithstanding, be necessary to give some estimate of the probable saving to be expected from its use.

In all trials made previous to the the 21st February, the machine had been worked upon no measured extent of ground; but the general effects were such, that several persons, of great experience in the management of roads, rated the daily work of the machine only as equal to the labour of fifty or seventy men, fifty being the lowest estimate ever named.

A few days afterwards, I directed some work to be done by measure; and I can now state it as the opinion of two very competent judges, that one machine will clear three miles in a day, twenty feet wide, (consisting of four lengths, and making the day's work twelve miles,) which is considerably more than one hundred and twenty men can do in a day.

120

	£.	s.	d.
120 men, at 2*s.* *per* day, - - - - - -	12	0	0
Four horses and two men can here be hired to work the machine for the day at - -	1	5	0
Difference - - - - -	£.10	13	0

At a distance, where carriages run principally in the centre of the road, the chief business in the management of it consists in keeping the sides clear and open. One machine may therefore be occasionally employed in outside work only; that is to say, may go six miles and return (making twelve miles as just mentioned), with the saving already given.

Whatever surprise these calculations may occasion, the public will perhaps be satisfied that I have not overrated them, when I produce the result of a fair experiment, made on the 25th February, 1803, in the presence of four trustees, (Frederick Page, Esq. Francis Page, Esq. Mr. Thomas Clark, and Mr. John Baily,) and others; by which it appears, that two miles, by measure, on the road to Reading, were cleared from mud, to the extent of eighteen to twenty feet wide, by two machines, in the space of two hours and a half, by the watch; and the work was judged to be equal to the labour of more than eighty men in a day.

The success of this experiment was so satisfactory to the above-named trustees, (for I was not present on the occasion,) that they directed, without my knowledge, the remainder of our district on this road, extending seven miles, to be cleared in the same manner; and I can now declare, with some degree of pleasure, that this was actually completed by two machines in one day, *viz.* on the following day, the 26th of February. Of this day's

work, I have heard it affirmed, by an experienced surveyor, that it could not have been done in one day by 400 men.

I confess that I am myself unable, from the want of practical knowledge on this subject, to form a comparative estimate between the work done by this machine and by hand. I have therefore sought for information from persons of respectable characters, who have been surveyors, or renters, of roads for many years; and I have been assured, as well by those who were present at the experiments as by others who examined the roads afterwards, that it would require sixty men a mile to do the work in one day which a single machine will accomplish at four lengths; and it has been already shewn, that three miles can, without difficulty, be cleared in a day: one machine will therefore do the work of one hundred and eighty men. But I have taken the average at only two-thirds of this estimate, *viz.* at forty men *per* mile instead of sixty, being more willing that the power of the machine should at present be under-rated than that the public should be deceived or disappointed concerning it.

The trustees of the London and Bath roads being desirous of having these two machines, which had been constructed on my account, and under my own inspection, for making the experiments, I have consented to dispose of them: and, as far as I am now able to judge, the price of a machine complete will be about ten guineas.

Finally, I must beg leave to advise those who are inclined to make a trial of this machine, to be careful whom they intend to employ in the construction of it; for, I can assure them, it is not sufficient to attend only to the form of the model, but it is absolutely necessary that

that the different parts, and especially the two braces behind, should be firmly put together, otherwise it will be impossible for it to withstand the force that must sometimes be exerted upon it by four or perhaps six horses. The scraper may be made of elm or beech, &c. but the other parts ought to be made of ash; and I must particularly recommend these materials to be well seasoned; all which circumstances were minutely attended to in the two machines which were made for me by Mr. Joseph Moss, of Greenham, near Newbury.

Certificates from Mr. George Goddard, Greenham, near Newbury, Mr. Francis Page, Mr. Frederick Page, Mr. John Baily, and Mr. Thomas Clarke, accompanied the above paper; stating that, on the 25th February, 1803, two miles had been cleared in two hours and a half by two of Dr. Winterbottom's machines.

References to Fig. 1, Plate IX.

Fig. 1, *a a*, two pieces of ash timber, forming at one extremity a pair of shafts *b b*.

c d e, three transverse braces to secure firmly the timbers above mentioned.

f, the iron plate, or front of the scraper, fixed within the braces *c d*, at an angle of thirty degrees, extending on the farther side two feet, and on the nearer side one foot and a half beyond the timbers.

g, an iron chain, one end of which is fastened to the outside of the timber *a*; the other end of the chain may be moved nearer to, or farther from, that end of the scraper which deposits the mud, by means of notches in the iron muzzle *h*, fixed to the scraper, and which regulates the draught of the horses attached to the ring at *g*.

k, the

k, the pole, or handle, to be made fifteen feet long; which passes through the strong holdfasts in the braces *c d*. This pole acts as a lever, as the scraper may be raised or sunk at pleasure.

The person who holds it may direct the scraper in its proper line, and assist it in overcoming any obstacle it may meet with in its way, or in giving it additional pressure where necessary.

i i, shew the two parts of the machine which form the feet, or sledge part of the machine, on which it slides when reversed, and which enable it to be removed from place to place when the scraper is not in use. These feet are strongly fixed to the timbers *a a*, and strengthened by a transverse brace betwixt them.

l, is the iron chain, or back-board, which lies upon the cast saddle of the horse in the shafts.

Fig. 2, shews, on an enlarged scale, the iron work, fixed on the outside of the shafts, to which the chain and horse are attached.

Fig. 3, describes, in a small extent, the track usually made by the scraper in a large way, in four rows, commencing at the arrow-mark, in the track No. 1, returning after it has gone any length required by the track No. 2, proceeding again by the track No. 3, and forcing the mud collected by the tracks Nos. 2 and 4 on the left of the road, as is more fully described in the preceding account, and thus clearing from mud a breadth of road twenty feet wide, by four passages of the machine.

Description

Description of a Ring, with an expanding and contracting Power to fit various-sized Fingers. Invented by Mr. J. D. Ross, *of Bateman's-buildings, Soho-square.*

With an Engraving.

From the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce.

Ten Guineas were presented to Mr. Ross *for this Contrivance.*

IF an improvement in the execution of jewellery work falls within the views of the Society for the Encouragements of Arts, &c. I beg leave to submit to them a method I have invented for setting rings, which, by means of a spring gage, accommodates itself to a finger of any size.

However well a ring may fit at one season of the year, it frequently happens to be either too tight or too loose at another. In one case the wearer is exposed to pain, and in the other to the hazard of losing perhaps a valuable ring. The trade will likewise be materially benefited, as they frequently lose the sale of valuable rings for want of that nice adjustment which this contrivance affords.

The setting itself is ornamental, and as it is enlarged or contracted at pleasure, may in all cases be worn with ease and safety. The additional expense will not exceed four or five shillings.

The trade in rings for home use and for exportation is reckoned the next in extent and value in the jewellery business to that of watch-making.

Re-

REFERENCE to Figs. 4, 5, 6, 7, 8, 9, Plate IX.

Fig. 4. The ring in its contracted state.

Fig. 5. The ring in its expanded state.

Fig. 6. The lower part of the ring separated from its collet, to shew the form of the springs. *a*, shews four small notches on the outer, which retain the ring at the size desired, the interior spring.

Fig. 7. A side view of the collet, where *c* shews the aperture into which the spring and notches of one side of the ring are introduced.

Fig. 8. A view of the top of the collet, with the stone taken out, where *d d* shew the small pins, which prevent the springs of the ring from drawing out when extended to their greatest diameter.

Fig. 9. A profile of half the ring, in order to point out more clearly the form of the notches.

On the Insects that prey upon Timber.

By the Rev. WILLIAM KIRBY.

From HUNTER'S GEORGICAL ESSAYS.

NO part of the economy of this terrestrial globe is more worthy of admiration, or furnishes a wider field for inquiry, than the methods by which all that vast variety of substances, animal and vegetable, which are produced from the earth, are kept within their proper bounds, and when life is departed from them are reduced to dust; so that a due harmony of parts is preserved, the relative proportion of individuals accurately adjusted to the wants and general good of the system; and those substances which have a tendency to deform or injure it, are in due time

time removed out of the way, and made to contribute under another form to its support.

Not to mention Man, and the various species of quadrupeds, birds, fishes, reptiles, and worms, which prey on animal and vegetable life; insects, although very diminutive, are very powerful instruments in the hands of the great Disposer of events, to promote, sometimes indeed by partial evil, the good of the whole. To them it is given in charge not only to prey on living substances, but also to hasten the dissolution and decomposition of those that are dying or dead. Of these none seem to have a more arduous task assigned them than those whose office it is to bring on, or accelerate the decay of the giant inhabitants of the forest. Numerous species of insects, and in various ways, labour in this department*. Some attack living trees, others those that are dead. Some deposit their eggs in them, that, when hatched, their larva may feed upon the wood; while others seek only a place well sheltered from wet, cold, birds, or other insects, for the habitation of their young. Again, some prey upon the soundest timber; while others make no attempt upon it till it begins to decay: but all contribute, in one way or other, to the same end; one taking up the office, which another resigns; till that which from its bulk and solidity appeared calculated to last as long as the earth that gave it birth, by the successive efforts of various kinds of insects, is reduced in no very long time to its original dust. So powerful are the effects pro-

* Insects are not the only labourers employed in this field; the same end is promoted by the Algæ and Fungi. Witness the numerous tribe of Lichens, Tremellæ, Agarici, Boleti, Auriculariæ, Sphæriæ, &c. which derive their nourishment from decaying wood, and assist in its decomposition.

duced by instruments which we too often overlook or despise.

To particularise some of the species employed in this work, and to point out what trees they attack either for food or to secure a sheltered situation for their offspring, may not be unentertaining, or altogether useless. I shall therefore mention a few of the individuals of each of the Linnean classes, omitting Hemiptera and Neuroptera, of which I recollect no species that feed or nidificate in wood; reserving the Coleoptera, which class sends forth the most numerous bands of these minute pioneers of nature, to the last; and concluding the whole with a short history of the Cerambyx violaceus of Linnæus.

Among the Lepidopterous insects, the larva of the Phalæna Bombyx Cossus is known to attain its great size by feeding upon the Willow, and other kinds of wood when in a decaying state. The same tree affords nourishment, as we learn from Mr. Lewin *, to the Sphinx crabroniformis; as does the Poplar to the Sphinx apiformis †, and vespiformis. The insects of the Hymenoptera class bring on the decay of ligneous substances in various ways. The nests and cells of many of the genuine Vespæ are made of a kind of paper formed of the filaments of wood. I have often been highly amused by seeing the common wasp, which, though mischievous, is at the same time a very ingenious animal, employed in scraping gate-posts with her strong maxillæ, to collect materials for this purpose; a sight which Reaumur informs us it was long before he could enjoy ‡. The hornet frequently perforates hollow trunks to build her paper

* Linn. Trans. vol. iii. p. 2.

† Ibid. p. 1.

‡ Reaum. Tom. vi. Mem. 6, p. 180, 181.

metropolis

metropolis in a sheltered situation *. The Leaf-cutter bees, of which there are several species, all confounded under the common name of A. centuncularis, in order to place their centunculi † of curious construction, in perfect security, make their way into the body of various trees. One species selects the Willow for this purpose ‡, another the Oak § or the Elm indifferently. Apis maxillosa ‖ nidificates in posts and rails. Apis violacea, as we learn from Reaumur ¶, constructs curious cells for its young, of several stories, in the supports of espalier trees. Apis furcata ⸸ makes similar cells in decaying wood. Many other insects of this class, particularly Spheges, and illegitimate Vespæ, emerge from cylindrial holes in trees and posts, in which they were nourished in their larva state.

* Ibid. Mem. 7, p. 217. I am informed by my friend, Sir Thomas Cullum, whose spirit and accuracy of observation throw light upon every branch of Natural History, that in the year 1785, in Mr. Porte's gardens at Ham, near Dovedale, the hornets destroyed a great number of the young Oaks, by making their way into their hearts, and there building their nests.

† Ibid. Mem. 4. Tab. 9. fig. 8—181. Tab. 10. Reaumur's species make its nest under ground; but Geoffroy's (Hist. ab. des. Ins. Tom. ii. p. 410. n. 5.) [illegible]r English ones make theirs in the trunks of trees.

‡ Raii Hist. Ins. p. 245. Sir E. King, in Philos. Trans. abridged by Lowthorp, vol. ii. p. 773. Willoughby, in do. p. 773, 774. Dr. Martin Lister, in do. p. 774.

§ Apis centuncularis, Donovan, Brit. Ins. vol. iv. Tab. 120.

‖ Marsham, in Linn. Trans. vol. iii. p. 27, 28.

¶ Reaumur, Tom. vi. Mem. 2. Tab. 5.

⸸ Furcata. A. cinereo pubescens; atra; antennarum articulo primo, fronte, labioque flavis; abdomine apice furcato; tarsis ferrugineis. Panzer. Fn. Ins. Germ. Init. No. lvi. Tab. 8. Obs. Panzer's insect is the male of this species.

Of Dipterous insects, the Tipula Pectinicornis, singular for the branching antennæ of the male, and many other species of that genus, in their lava state, inhabit putrescent wood *: and a numerous army of the Oniscus Asellus, to name no other insect in the Aptera class, is generally to be met with in those parts of decaying trees under the bark, which are deserted by other insects; upon which, from its saw-dust-like excrement, it appears to feed.

Having gone over the other classes, it remains that we mention the devourers of wood amongst the Coleoptera. Foremost in the ranks comes the gigantic Lucanus Cervus, whose larva feeds upon the decaying wood of the Oak † and the Elm. In the latter is also found the Lucanis Inermis ‡. The Ash affords nourishment both to Lucanus Parallelipipedus and L. Cylindricus. (Scarabæus Cylindricus of Linn. but surely a true Lucanus.) The several species of the genus Ips (Bostrichus Fab.) feed upon timber between the bark and the wood, upon the surface of which they usually trace in feeding, what Linnæus calls Pinnated Labyrinths, in which a number of lateral lines, nearly parallel with each other, form right angles on each side, with a central one; and thus the bark is finally separated from the wood. Most trees, I imagine, have a particular species of this genus assigned to them. Thus Ips Piniperdus attacks the Fir.

* Habitat in carie arborum solitaria larva, pupaque. Schrank. Enum. Ins. Austr. p. 423. n. 853. I have found the pupa in the same situation.

† In Europæ ligno quercino putrido. Linn. Syst. Nat.

‡ Inermis, 2. Scutellatus, convexus, brunneus, maxillis, brevibus, dente laterali elevato. Marsham, MS.

Ips

Ips Scolytus, the Elm. Ips Niger *, I. Griseus †, I. Rufescens ‡, and, I believe, I. Nebulosus §, undertake the barking of the Ash. Ips Fuscus ‖, and probably more species, feed upon the Oak. Even shrubs do not escape, for whin or furze (Ulex Europæus) is preyed upon by the minute Ips Rhododactylus ¶, which I have frequently taken coming out of the larger sticks of a dead whin fence in my own garden. Next to these come the Ptini; several species of which are found in wood. I meet with Ptinus Tessellatus in the Willow, and I believe it will attack Deal, or any soft wood. It is one of those insects that is called the Death Watch, from a certain sound which it makes at regular intervals resembling the clicking of a watch, which the vulgar superstitiously imagine forbodes the death of some person in the house in which it is heard. The Ptinus Pectinicornis also, and Pt. Cylindricus ✝, feed in the same tree. But of all the species of this genus, Ptinus Pertinax is the most mischievous; any kind of wood that begins to have a tendency to decay it attacks without mercy. I speak this from expe-

* Niger 24. I. subcylindricus, niger, thorace punctulato, elytris crenato-striatis, plantis piceis. Marsham MS.

† Griseus. [illegible]. I. ferrugineus, capite nigro, supra ferrugineo testaceoque varius. Ibid.

‡ Rufescens. 10. I. subtus luteus, supra rusus, elytris luteo nebulosis. Ibid.

§ Nebulosus. 8. I, subvillosus, corpore nigro cinereoque vario. Ibid. Bostrichus Fraxini: ater fusco cinereoque varius, elytris punctato striatis, antennis testaceis clavâ cinereâ acutâ. Panz. Fn. Ins. Germ. Init. n. 16. Tab. 63.

‖ Fuscus. 5. I. fuscus, antennis pedibusque testaceis; elytris retusis confertius punctulatis. Marsham, MS.

¶ Rhododactylus. 22. I. niger, villosus totus, plantis rufis. Ibid.

✝ Cylindricus. 6. Pt. subcylindricus fusco ferrugineus; thorace gibbo læviusculo; antennis pedibusque rufescentibus. Marsham, MS.

rience,

rience, having a chamber in my house, the floor of which is quite filled and perforated in every direction by this destructive little insect; and my walnut-tree chairs it has nearly reduced to the same state that Linnæus observes it has done his *.

Amongst the Curculiones, the late ingenious Mr. Curtis has informed us, that C. Lapathi feeds upon the Willow †. C. Lignarius ‡ preys upon the trunk of putrid Elms; and C. Atramentarius § I have found in all its states in old rails under bark. There is one insect, which although not yet discovered in England, ought not to be passed over, as its history furnishes a striking proof how useful the study of natural history may be made, when applied to economics; the insect I allude to is the Cantharis Navalis of Linnæus. Dr. Smith, the liberal possessor of the Linnæan treasures, informs me, from the Iter Westrogothicum, that the oak-timber in the royal dock-yards in Sweden being observed to have suffered considerable injury from some unknown animal, Linnæus was desired by his Swedish Majesty to trace out the cause, and point out some remedy which might prevent the farther progress of so alarming an evil. Upon inquiry he discovered that the mischief was occasioned by this Cantharis, and he recommended that the timber should be immersed in water during the usual time of this insect's appearance. This advice was pursued, and the dock-yard timber received no farther injury.

* Terebravit et destruxit sedilia mea. Linn. Syst. Nat.

† Linn. Trans. vol. i. p. 86.

‡ Lignarius. 113. C. nigro piceus totus, rostro crassiusculo, thorace punctato, elytris abbreviatis. Marsham, MS.

§ Atramentarius 165. C. ater obovatus, thorace utrinque unidentato, elytris striatis. Ibid.

We

We have so few species of the genus Buprestis in England, and those that we have are so seldom met with, that it is no wonder if the habitation of their larvæ is not commonly known; both De Geer * and Geoffroy †, however, are of opinion, that they are inhabitants of wood. But the timber-merchant and the builder have no greater enemies than the genuine Cerambyces, under which genus I would, with De Geer ‡, include those only which have reniform or lunar eyes, excluding C. Cursor, Lamed, Meridianus, Inquisitor, &c. and taking in Leptura Alni, Arcuata, Arietis, Mystica, Præusta, &c. of Linn. These insects, as far at least as we are acquainted with them, not only devour the surface of the wood that lies under the bark, but penetrate deep and in all directions into the solid timber. What havock must the larvæ of so large an insect as Cerambyx Coriarius make in an oak tree §! I have taken the pupa of Cerambyx Arcutatus out of the heart of a solid piece of the same timber, which had been perforated by that insect in all directions. Once in the height of summer, when the mid-day sun shone out warm, I was very much entertained with seeing several of these fine insects fly down upon a pollard oak that had been felled and the bark left upon it, and run all over it with great velocity, seeking, it is probable, a place proper for depositing their eggs.

Amongst the Cerambyces of this country, the ingenious Mr. Donovan, in his elegant work upon British insects ||, has figured C. Violaceus, and informs us that it

* De Geer, Tom. iv. p. 131.

† Geoffr. Tom. i. Cucujus, n 1. p. 125. n. 2. p. 126.

‡ De Geer, Tom. v. p. 55, 56.

§ Habitat in betulis putridis. Linn. Syst. Nat. But I have known it cut out of an oak.

|| Donov. Brit. Ins. vol. ii. p. 73. Tab. 61. fig. 1.

probably

probably feeds upon the fir, but at the same time expresses a strong suspicion that this beautiful insect is not originally English. How far this may be true it is not my intention to inquire; I shall only observe, that it is now become but too common, at least in one spot, in the neighbourhood of London, as will appear from those circumstances of its history which I am going to relate.

My friend and relation, Mr. James Trimmer, of Old Brentford *, an attentive observer of Nature, more particularly of the economy and habits of insects, and to whom I am indebted for much curious and interesting information in this branch of science, some time ago wrote to inform me, that he had found this insect in its three states in fir-timber, and accompanied this intelligence with many ingenious remarks. Expecting him soon to visit me at Barham, in my answer I requested him to bring with him some of its larvæ and pupæ, and also some pieces of the wood upon which they had been feeding; at the same time I desired him to continue observing their motions. What follows relative to the history of this Cerambyx is chiefly compiled from his communications, which I thought too interesting to be lost. The fir in which Mr. Trimmer first found this insect was of English growth, of the spruce kind, which had not been felled many years, and had originally grown near the spot on which the building was erected, in which it was employed: it did not appear to have been attacked more than two years when Mr. Trimmer made his observation; and it suffered most in 1798, when the larvæ had multiplied so much, and been so extremely voracious, as

* Son of Mrs. Trimmer, so justly celebrated for her humane and successful exertions to procure the great blessing of a religious education for the children of the poor.

to

to have left very little food for another year. Some Scotch fir, in an adjacent building, had also been attacked by them. Nor does this insect so intirely confirm itself to fir as never to attack any other kind of wood; for when the imago first came forth in considerable quantities, Mr. Trimmer took several, and placed them upon some pieces of fir which were under cover: but what seems remarkable, the insects quitted these, and went and deposited their eggs in some pieces of apple, pear, cherry, and plum, which had been selected for turning, and were piled up in the open air.

It is worthy of observation, that this destructive little animal attacks only such timber as has not been stripped of its bark; a circumstance which ought to be known and attended to by all persons who have any concern with this article; for the bark is a temptation, not only to the insect in question, but also to a numerous tribe both of this and other genera; and a great deal of the injury which is done to timber would be prevented, if other trees, besides the oak, were barked as soon as they were felled. The principal danger, however, arises from neglecting this precaution with respect to such timber as used in buildings, especially in those plaoes that are accessible to insects, for in this case it will not last out half its time.

But to proceed with our history, the female of this insect is furnished with a flat, retractile tube, or rather aculeus *, which she inserts, it should seem, (for Mr. Trimmer was never so fortunate as to see this operation performed,) between the bark and the wood to the depth of about a quarter of an inch, and there she deposits her egg, since not more than one appears to be laid in one place.

* Tab. 12. fig. 15. C. Linn. Trans. vol. v.

place. By stripping off the bark it is easy to trace the whole progress of the larva from the spot where it was newly hatched, to that where it has attained its full size *. At first it proceeds onwards, but in a serpentine direction, filling the space which it leaves behind with its excrement, resembling saw-dust, and so stopping all ingress to enemies without; but when it has arrived at its utmost dimensions, it does not confine itself to one direction, but works in a kind of labyrinth, eating backwards and forwards, which gives the wood under the bark a very irregular surface †; by this means its paths are of considerable width. Its attacks are not confined to the solid timber, but in its progress it eats away an equal portion of the bark. The bed of those paths where it has been at work exhibits, when closely examined, a curious appearance, occasioned by the erosions of its maxillæ, which excavates an infinity of little ramified channels. When the insect is about to assume the pupa, it bores down obliquely into the solid wood, to the depth sometimes of three inches, seldom if ever less than two. These holes ‡ are nearly semicylindrical, expressing exactly the form of the grub. One would wonder how so small, and seemingly so weak an animal could have strength to excavate so deep a mine; but when we see its maxillæ, our wonder ceases; these are large, thick, and solid sections of a cone divided longitudinally §, which, in the act of mastication, apply to each other the whole of their interior plane surface, so that they grind the food of the insect like a pair of mill-stones. Early in March all the larvæ, except some sickly ones, were observed to

* Fig. 13. *a—c.*

† Tab. 12. fig. 14. Linn. Trans. vol. v.

‡ Fig. 14. *a, a, a.*

§ Fig. 5. *b, b.* Fig. 7. *b.* Linn. Trans. vol. v.

have

have entered the wood in this manner; some began so soon as October. At the place in the bark opposite to this hole the imago gnaws its way out of its prison when it makes its appearance, which took place first on the 20th of May, and continued till about the 20th of June; it returns by the same passage which the larva had excavated previous to assuming the pupa. Mr. Trimmer thinks that these insects fly only during the night, as in the daytime he always found them standing upon the piece of wood from which they had been disclosed. The case is different with Cerambyx arcuatus, which, as I observed before, flies at mid-day: but perhaps this circumstance may depend much upon the state of the atmosphere, or the hour of the day; for many insects have their certain hours for flying; a singular instance of which I had once an opportunity of witnessing. In the beginning of July, 1793, about ten o'clock in the morning, as I was passing through a meadow, I was surprised with the appearance of what at first seemed to me to be myriads of bees flying about the hedges and trees; but upon taking some of them, they proved to be Scarabæus argenteus (Melolontha argentea Fab.); upon my return through the same field, a little after noon, I was astonished to find that of this infinite host of insects not a single one was to be seen.

I have now communicated all the observations which Mr. Trimmer made with respect to the history of this insect; these I hope will not be thought unworthy of the attention of the public, since they furnish an useful lesson in economics, and supply an additional proof of the utility of the study of Natural History, and to what good purposes it may be directed.

On the Cultivation of Willows. By ROBERT LOWE, *Esq.*

FROM HUNTER'S GEORGICAL ESSAYS.

I WOULD first advise the laying out the ground into lands, like hop lands, *viz.* from three to four yards wide, with a ditch on each side, three feet wide at the top, one foot at the bottom, and two and a half deep. The earth that comes out of the ditch should be thrown on the land. But if there is not full sufficient fall for the water to get off, the ditch should be deeper and wider, till you have near a yard of earth above the level of the water.

As soon as this is done, the ground must be double dug, *viz.* trenched two spades depth, except your ground be very boggy, which will afford room for the plants to shoot, and will save the expense of weeding, which otherwise must be incurred in the first summer after the plants are set; for if they are not kept clear of weeds the first year, the hopes of the planter will certainly be destroyed.

The willow I recommend as most advantageous on every account, is the broad-leaved red-hearted Hunting-donshire willow; every other species I have tried, and find reason to give a decided preference to this.

The sets, or truncheons, may be cut from twenty inches to two feet long; particular care should be taken in the cutting, that the bark should not be fridged or bruised, or in other respect injured; for in that case the plant will be weak and puny. They should be cut not on a block, but in the hand; obliquely, and with a very sharp bill or instrument. They must be dibbled into the earth by an iron crow, to the depth of fourteen or twenty inches, so that not more than six, or less than four, appear above. If the truncheon should not fill the hole, the

earth

earth must be trampled close round it, in order that the air may be excluded. Care must be taken that the plant be set as the pole grows. The cuttings should be from poles of about three years growth. Maiden poles are the best; they should be set three feet asunder in the quincunx form, as thus:

* * * * *
* * * * * * *
* * * * * *

Those truncheons will shoot out many branches, two or three of which will grow to poles, if the land is good; if not, only one. Those poles I have sold, at eight years growth, for 214*l.* *per* acre, neat money; the kids, or brushwood, pay for the felling. Had I suffered them to have stood two years longer, they would have produced 300*l.* *per* acre. Should any of the plants look weak or puny, or not shoot vigorously, it will be necessary to dig in a skuttle-full of manure to the roots, which I have no doubt in saying will pay.

Though I have planted no less than ten acres, I cannot say positively, from my own knowledge, what the value would have been had they remained on the ground for fifteen or twenty years, having been called on for sets, by the gentlemen of the neighbourhood, which I have sold for three pound a thousand. I must here observe, that the stools whence the sets are cut shoot very luxuriantly, and will produce from three to four poles.

The length of poles, at eight years growth, were from thirty-three to thirty-six feet, and most of them were large enough to make three rails, two at the bottom and one at the top; but the great use to which they are applied, is for the purpose of making hurdles, flakes, gates, and other farming implements, being a wood uncommonly tough and light, owing, as I conceive, to a new method

method I made use of in planting them close to the ground. If it is the design of the planter to let them grow into timber, (which I would venture to say would be far superior to *deal* for the purpose of flooring, or other light work, particularly as it will neither splinter nor fire; and if suffered to remain for twenty or twenty-five years, would make good masts for small craft, as they shoot up perfectly straight, and without any collateral branches,) it is necessary, at the first or second year's growth, to observe which pole is the strongest, as the remaining poles must be cut away. In about fifteen years times, I am led to suppose, they will want thinning: of course the inferior must be taken out, and the superior be suffered to remain.

The times of planting must be from January to the end of March; but the sets for that purpose should be cut from December to the end of February, when the sap is down. And the reason is, that if poles are cut in the spring (the sap being up) the stool will at last be weakened by bleeding, if not killed; and of course prevented from shooting so vigorously as if cut at the preceding time. If, however, there are people so injudicious as to sell sets in spring, it will be to the advantage of the purchaser to plant them, as the sap is then in the poles. The reason why many are induced to cut poles at that time, is on the supposed account of their peeling better; but I can affirm from experience, that poles cut in December, January, or February, and laid in rows upon the ground, or the ends put in water, will peal as well in the spring as at the usual time.

In regard to fencing, the planter should pay the greatest attention to it, otherwise his time and expense will be fruitless.

Memoir

Memoir on Areometers. By M. Barré, *of Orleans.*

With Two Plates.

From the Journal de Physique.

In the study of the sciences, and the cultivation of the arts, the saving of time is a matter of such consequence, that means have continually been sought for simplifying experiments of inquiry. In physics, and especially in chemistry, it is of such great importance to know the densities or specific weights of bodies, that scientific men have at all times occupied themselves with the investigation and improvement of the means proper for indicating them.

Although of all the qualities of bodies their density is one with which we are the most accurately acquainted, yet none of the instruments which are employed for ascertaining it combines all the advantages that might be desired. The hydrostatic balance gives sufficiently-accurate results, and affords the two-fold advantage of indicating the densities both of solids and liquids; but the use of this instrument is inevitably tedious. Besides, this expensive apparatus is liable to be spoilt, and to lose its accuracy and precision, in a chemical laboratory.

The gravimeters of Nicholson and of Fahrenheit lead to still more accurate results. The use of the first is applicable to solids as well as liquids; but these instruments, besides being expensive, and very apt to be broken, require long and tedious operations, and frequently give occasion to errors in calculation, which oblige us to repeat them again from the beginning.

The areometers, though intended only for the investigation of the densities of liquids, present inestimable advantages by their simplicity, their cheapness, and especially

cially by the facility of their use and the celerity of their operation. But these instruments are still very far from that degree of perfection which it would be desirable to give them.

Several works have appeared on the subject of areometry; but nevertheless this part of physics, with respect to its application in practice, is still in its infancy, if the areometers in use are the only fruit of all the investigations of the learned. Some acquaintance with the principles of hydrostatics, and the inspection of these instruments, are sufficient to shew that they indicate nothing more than that such a liquor is more or less heavy than such another, without determining the relation of their densities; that they have no other advantage over the first which appeared (that of Hypatia) than that they sometimes admit of comparison with each other I say sometimes, because only few of these instruments do it.

In fact, according to whatever methods the areometers of Beaumé and those of Cartier, which are the only ones which I know, may be constructed, these instruments cannot all admit of comparison. Independently of the negligence of the artists, the data which serve for their bases being almost all of them arbitrary, are susceptible of great difference with different artists, and of thus producing a variation in the results even with each individual. For notwithstanding every precaution, the density of the liquids which are employed for graduating these instruments is not always uniform. Not to mention the variation of temperature, which every artist no doubt takes into consideration, the evaporation, the repeated immersion of these instruments into different liquids, without being well dried, together with an infinite number of circumstances and accidents, insensibly change the density of the liquids, and lead to erroneous results which

which are but rarely perceived, and which cannot be rectified with proper accuracy. The standard which every artist makes for himself, for the purpose of verifying his operations, is not exempt from danger. The slightest accident may deprive him of it. If he thinks to repair his loss by substituting in place of this instrument another, which has been modelled according to it, it is at the risk of error; for the two are not perfectly alike.

This winter (year 10) as I attended M. Vauquelin's course of chemistry, I became more than ever convinced of the insufficiency of these instruments, and even of their uselessness, in operations where it was necessary to know the specific weight of different liquids, whether they were the products or the subjects of these operations. I became more and more persuaded of what importance it would be for persons who occupy themselves with the physical sciences, and especially with chemistry, to have instruments speedy and expeditious in their use, for determining with accuracy the specific weight of liquids.

These considerations induced me to endeavour to correct the areometers at present in use, or to contrive others equally simple, but more capable of comparison, and more proper for indicating the densities of liquors. If I have not attained my object as completely as a scrupulous observer might desire, my researches have at least led me to a result which will facilitate his operations, save his time, and enable him to multiply his experiments and observations.

The task which I took upon myself did not at first present to me all the difficulties which I afterwards found were to be surmounted. To derive from nature all the data which were to serve me as basis, so that all these instruments, constructed upon fixed and invariable principles, might be susceptible of comparison, and to give

to each division of the scale an expression that should indicate the density of the liquid of which it should mark the degrees of immersion, were the first points with which I occupied myself, and that without much impediment, and with tolerable success; but the case was different when I had to contrive a method equally expeditious and easy for dividing the scale of the areometers conformably to the laws of hydrostatics.

In the areometers in common use, the divisions of the scale being equal, seem to indicate densities which are in arithmetical progression, that is to say, which differ all by the same quantity; but it will be seen that the degrees of the areometric scale cannot be equal to indicate equal differences in density.

The end which I propose to myself is, therefore,

1. To apply to areometers a scale proper for indicating, within a thousandth part of the unit, the densities or specific weights of the liquids, and consequently to render these instruments capable of comparison.

2. To furnish artists with means, both easy and exact, for constructing them well.

In order to accomplish the first object, I shall explain the principles upon which the divisions of the areometrical scale in general are founded. I shall accomplish the second by pointing out to the artist easy means for applying these principles to the graduation of areometers. The first part will be purely theoretical, and the second practical.

I. From that general principle of hydrostatics, that "the densities or specific weights of bodies are in the direct ratio of the masses and the inverse ratio of the volumes," it follows,

1. That the divisions of the areometrical scale must not be equal to indicate equal differences in density.

In

In fact, the degrees of the scale of an areometer are determined by the differences of the portions of the volume, immersed in the different liquids. In order that these degrees should be equal, it would be necessary that the volumes of liquid which it displaces by its immersions should be in arithmetical proportion, like the densities, which would be an absurdity.

2. That the degrees of the areometrical scale, to indicate equal differences of density, must be in the ratio of differences of the fractions reversed which express these densities.

Thus when we express by $\frac{a}{a}=1$, the unity of density which serves for the term of comparison, the different degrees of density of the different liquors may be expressed in general by the following series:

$$\frac{a}{a},\ \frac{a\pm1}{a},\ \frac{a\pm2}{a},\ \frac{a\pm3}{a},\ \ldots\ \frac{a\pm n-1}{a}$$

Moreover, the volumes of the liquids displaced by the immersions of the instrument being in the inverse ratio of the densities, these volumes, will be as the fractions reversed, which express these densities, and represented by the terms of the series:

$$\frac{a}{a},\ \frac{a}{a\pm1},\ \frac{a}{a\pm2},\ \frac{a}{a\pm3},\ \ldots\ \frac{a}{a\pm(n-1)}$$

Consequently the intervals of the degrees of the areometrical scale must be the differences of the terms of the same series;

that is to say, as $\frac{a}{a}-\frac{a}{a\pm1},\ \frac{a}{a\pm1}-\frac{a}{a\pm2},\ \frac{a}{a\pm2}-\frac{a}{a\pm3},\ \frac{a}{a\pm3}-\frac{a}{a\pm4},\ \ldots\ \frac{a}{(a\pm n-2)}-\frac{a}{a\pm(n-1)},$

And, making only a single fraction of each term, the degrees of the scale will be expressed by $\pm\frac{a}{a^2\pm a+0}$,

$$\pm\frac{a}{a^2\pm3a+2},\ \pm\frac{a}{a^2\pm5a+6},\ \pm\frac{a}{a^2\pm7a+12},\ \ldots$$

$$\pm\frac{a}{a^2\pm(2n-2)a+n.n-2}.$$

 The

The positive terms give the degrees which indicate the densities superior to the unity, and the negative terms indicate the densities inferior to the unity.

Now, to determine upon an areometer the different points of immersion, which are to indicate the degrees of density of the liquids, the instrument is plunged into the liquid whose density is expressed by the unity $= \frac{a}{a}$. Let this areometer, for example, be represented by the cylinder A B C Fig. 1, Plate X, and C be the point of immersion. This body being cylindrical, the immersed portions of its volume may be expressed by lines compared with the length A C, and carried all from the extremity A of the instrument upon its length, to determine by their differences the divisions of its scale.

Consequently, the first line A C being expressed by $\frac{a}{a}$, the other will be as this series:

$$\frac{a}{a \pm 1}, \frac{a}{a \pm 2}, \frac{a}{a \pm 3}, \ldots \frac{a}{a \pm (n-1)}.$$

The sign + will of course determine the inferior degrees, and the sign — the superior.

If the point of immersion C was taken in a liquid of another density than that expressed by $\frac{a}{a}$ as for example, $\frac{a}{a \pm 7}$; all the lines compared with A C would be expressed by $\frac{a}{a \pm 8}, \frac{a}{a \pm 9}, \frac{a}{a \pm 10}, \frac{a}{a \pm 11}, \frac{a}{a \pm 12} \ldots$ $\frac{a}{a \pm (n-1)}$.

And by $\frac{a}{a \pm 6}, \frac{a}{a \pm 5}, \frac{a}{a \pm 4}, \frac{a}{a \pm 3}, \frac{a}{a \pm 2}, \frac{a}{a \pm 1}, \frac{a}{a}, \frac{a}{a \pm 1}, \frac{a}{a \pm 2}$, &c.

The first series will determine the inferior degrees in the case of the positive sign, and the superior in case of the

the negative sign. The second series will determine the degrees in the opposite direction.

But I observe that the figure of the instrument cannot be cylindrical in its whole extent, without requiring a very considerable length. These instruments, in order that they may float upon the liquids in a vertical position, require to have the centre of gravity very near their lowest extremity. In order to diminish their length and render them convenient in the use, they are generally made in the form of a hollow bulb D, Fig. 2, which bulb is surmounted with a cylindrical stalk B C, and elongated below into a short stalk, at the extremity of which is a small bulb A, which serves for ballast. The size of this bulb is regulated in proportion to the densities of the liquids upon which the insrtument is to float.

This figure however makes no alteration in the theory; for whatever be the figure of the portion of the instrument which is constantly immersed in the liquid, it produces no change in the relations of the volumes of the liquids displaced. But as the volume of the immersed part A B D cannot be appreciated by its length, it is necessary that two points of immersion should be taken upon the stalk B C, in order to determine the value of each of the degrees of this instrument.

Supposing, for example, that B and C are the two points of immersion in two liquids, the densities of which are expressed by $a - 4$ and $a + 6$, the spaces from the point B to the point C will be as this series:

$$\frac{a}{a^2 - 7a + 12}, \quad \frac{a}{a^2 - 5a + 6}, \quad \frac{a}{a^2 - 3a + 2}, \quad \frac{a}{a^2 - a}, \quad \frac{a}{a},$$

$$\frac{a}{a^2 + a}, \quad \frac{a}{a^2 + 3a + 2} \cdots \frac{a}{a^2 + 11a + 30},$$ and so forth for the degrees under B.

Those

Those above C will be: $\frac{a}{a^2 - 9a + 20}$, $\frac{a}{a^2 - 11a + 30}$, ... &c.

This being supposed, if we make $a = 10$, $a = 100$, $a = 1000$, we shall have degrees which will indicate the densities expressed in tenths, hundredths, or thousandths, of the principal unity. Making in this example $a = 10$, the space between C and B will be as, $\frac{10}{42}$, $\frac{10}{56}$, $\frac{10}{68}$, $\frac{10}{90}$, $\frac{10}{100}$, $\frac{10}{132}$, $\frac{10}{156}$, $\frac{10}{182}$, $\frac{10}{210}$, $\frac{10}{240}$. From whence it results:

1. That each denominator indicates into how many parts the interval B C ought to be divided, in order to give ten of these parts to the degree which corresponds with it.

2. That in order to perform only a single operation, it would be necessary to divide B C into as many equal parts as should be expressed by the product of all the denominators of the series, and to reduce all the terms to a common denominator, in order to give to each degree as many of these parts as should be marked by its corresponding numerator.

3. That if it is easy to determine by calculation the value of each of the degrees of the scale of an areometer, it is not so to assign to it this value in the application.

If when we consider the densities as expressed only in tenths, the division of B C already presents great difficulties; this division will be physically impossible, if the densities are expressed in hundredths or thousandths of the principal unity; for I observe, that if $a = 100$, or $= 1000$, the number of the spaces of the interval B C is decupled or centupled, and that each denominator is a hundred times or ten thousand times larger; and in the second place, that the difficulties in the division of the lines

lines increase in a ratio compounded of the direct of the number of parts and the inverse of their magnitudes.

Without a particular method, the graduation of aerometers, conformably to the laws of hydrostatics, could therefore not be effectuated by the means which are commonly employed for the division of lines.

After having relinquished several mechanical means which were either too tedious or too inaccurate, I represented to myself an arbitrary triangle, the base of which was divided into a certain number of equal parts, and I drew, in idea, a line to each point of division of the base of this triangle. I then imagined that a line drawn in this triangle, and intersected by the oblique ones, must afford me,

1. An infinity of positions more or less oblique to the base.

2. In each position a series of spaces the proportion of which must increase from equality according to an uniform law.

3. That in one of its positions this line might perhaps afford me a series of spaces proportional to the degrees of the general areometrical scale.

Encouraged by these considerations, I undertook some researches, and without much difficulty arrived at my intended purpose. The following is the method which I discovered for dividing, by intersections, any line into parts proportional to the differences of the reversed fractions which express the densities in arithmetical proportion.

Upon an indefinite line A B (Fig. 3, Plate XI.) I take at pleasure three equal parts, A D, D E, E B, upon the sum of which I form the arbitrary triangle A C B *; from the summit

* If in the theory the figure of this triangle is arbitrary, it is useful to give it a determinate figure in practice. The intersections of the lines

summit C of this triangle, and through each point of the division of the base, I draw C D and C E which I lengthen indefinitely; through the point E, I draw parallel with C B the indefinite lines E F, and through the point C, parallel with A B, I draw C F.

Now if I represent by E B the principal unity of density, or the density of the liquid taken for the term of comparison, D B will represent a double and A B a triple density.

This being supposed, I say that F E represents the unity of the volume of the instrument immersed in the liquid, the density of which is expressed by $\frac{a}{a} = 1$; F H the portion of the volume immersed in a liquid the density of which is double, and F G that immersed in a liquid of a triple density, F E and C B being parallel, F E $+ \infty$ will represent the infinite volume immersed in the zero of density.

In order that this principle be true in its generality, the densities being expressed by o, a, $2\,a$, $3\,a$, it is necessary that F E $+ \infty$, F E, F H, F G, &c. should be expressed by $\frac{a}{o}$, $\frac{a}{a}$, $\frac{a}{2\,a}$, $\frac{a}{3\,a}$, &c. And this is very evidently the case.

In fact, the triangles F G C, F H C, F E C, each similar to their correspondent ones A G E, D H E, E C B, give C $= \frac{A\,B}{3}$, F H $= \frac{1}{2}$ D B, F C $=$ E B; consequently E F, which represents the unity of the volume

lines are the more exact in proportion as they approach to the right angle. The figure most favourable to the accuracy of the intersections of D B and H B, which are the most necessary in practice, is that in which the lines D C and B C are perpendicular. The lines C D and H E, as well as C E and D B, in this case, are also perpendicular. See Fig. 4, Plate XI.

of

of the instrument being expressed by $\frac{a}{a}$, we have $FG = \frac{a}{3a}$, $FH = \frac{a}{2a}$, $FE = \frac{a}{a}$, $FE + \infty = \frac{a}{a}$.

The parts of $FE + \infty$ being in the proportion of the reversed fractions which express the densities of the liquids, the spaces G E, H E, &c. are therefore as the differences of the same reversed fractions; the spaces of $FE + \infty$ are therefore proportional to the degrees of the general areometrical scale.

If we make $a + 2$, each part of A B will be divided into two equal parts. Drawing from the angle C an oblique line to each point of division, *a*, *d*, *b*; F E being prolonged, will be intersected at *g*, *h*, *e*, and give the degrees for indicating the relation of the densities in $\frac{1}{2}$ of the principal unity. The densities will be expressed by o, $\frac{1}{2}a$, a, $\frac{3}{2}a$, $2a$, $\frac{5}{2}a$, $3a$; the volumes of liquid displaced will be as $FE + \infty$, Fe, FE, Fh, FH, Fg, FG, &c. or as $\frac{a}{o}$, $\frac{a}{\frac{1}{2}a}$, $\frac{a}{a}$, $\frac{a}{\frac{3}{2}a}$, $\frac{a}{2a}$, $\frac{a}{\frac{5}{2}a}$, $\frac{a}{3a}$, &c.

If we make $a = 10$, $a = 100$, $a = 1000$, &c. each part of A B will be divided into 10, 100, or 1000 equal parts; and the obliques drawn from the point C to each point of division of A B will give by their intersections upon the line F E prolonged, the proportions of the degrees of an areometer, to indicate by its immersions the densities of the liquids expressed in tenths, hundredths, or thousandths, of the principal unity; as is evident.

TO BE CONTINUED IN OUR NEXT.

Experiments on Raw Platina, on the Existence of several Metals, and of a new Species of Metal in this Ore. By Messrs. FOURCROY *and* VAUQUELIN. *Read to the National Institute.*

From the ANNALES DE CHIMIE.

THE observations contained in this memoir were made, in endeavouring to purify platina, in order to repeat the experiments of M. Muschin Puschkin, which we were several months before directed to do by the class, and those of M. Chenevix, on the composition of the palladium; respecting which, we shall make our report to the class upon a future occasion.

It is already several months since we obtained the principal results of this inquiry; but knowing that M. Descotils occupied himself with the same object, and that he suspected the presence of a new metal in it, we did not wish to anticipate him with the institute, or deprive him of the credit to which he is intitled for his labours.

It will appear that our experiments prove very nearly the same things which his do; and that, receiving reciprocal confirmation from each other, they render the results which they announce more worthy of confidence.

Experiment I.

In order that we might operate upon purer platina, we separated from it mechanically, as accurately as we were able, the gold and ferruginous sand which are mixed with it. We afterwards boiled 250 grammes of this platina, thus cleaned, with a large quantity of concentrated muriatic acid. This acid assumed a yellowish colour, and disengaged sulphurated hydrogen gas; when it appeared

peared to act no longer, we decanted it, and washed the platina.

We again boiled the platina with nitric acid, which also assumed a yellow colour, though not so intense a one as the muriatic acid. Finally, we boiled it for the last time with sulphuric acid, which likewise became slightly coloured. The platina thus washed with those three mineral acids, had lost seven grammes of its weight.

Experiment II.

Before proceeding farther, we thought it necessary to examine our acids, in order to ascertain the nature of the matters which they had separated from the platina.

The muriatic acid was distilled to the consistence of a syrup; the liquor which passed over contained white shining filaments, which were nothing but pure sulphur, proceeding, undoubtedly, from a portion of hydrogen gas which had remained in solution in the muriatic acid, and which the concurrence of the heat and air had decomposed. The ore of platina contains therefore a metallic sulphuret.

The liquid which had remained in the retort, being mixed with water, formed a greyish white precipitate, which, suspended in the liquor, gave it a milky appearance, and which soon collected in the form of flakes.

The liquor which swam at top had a yellowish-green colour; it gave a greenish blue precipitate with the prussiate of potash, a brown one with gall-nuts, and a red-brown one with caustic potash; phenomena which indicated that the iron contained in this liquor was not pure.

The white flaky precipitate above-mentioned, when washed and dried in the air, weighed one gramme and a half; its colour was greyish. The following are the properties which it exhibited to us: 1, Treated with concen-

concentrated and boiling muriatic acid, it was in part dissolved, and the solution was of a yellowish colour and an austere taste; 2, This solution mixed with sulphuret of potash gave a pale-yellow precipitate; 3, With the prussiate of potash a precipitate of a very fine green, which neither the acids nor the contact of the air rendered blue; 4, With the infusion of gall-nuts, a precipitate of a blood-red colour; 5, Finally, a milky-white precipitate by the mere addition of water.

These effects indicate very plainly that the matter separated from platina by the muriatic acid, and precipitated by the water from its concentrated solution, is real oxyde of titanium.

Thus the muriatic acid, in boiling upon the platina, dissolved oxyde of iron and oxyde of titanium, undoubtedly united together in the ore of platina. We may therefore already reckon among the substances which accompany the platina, and which form in some measure its gangue, sulphurated iron, and the ferruginous titanium, or the menacanite of mineralogists.

We have said above, that only a part of this matter precipitated by water had been dissolved by the muriatic acid; that which remained had a grey colour; heated with nitro-muriatic acid it became white, and was in part dissolved; the solution presented nearly the same phenomena as the first. But there still remained a small quantity of black powder which the nitro-muriatic acid did not dissolve, which did not colour borax green like titanium, but which was reduced to the metallic state, in the form of small white lamellæ.

Concerning this substance we shall speak again hereafter.

Experiment

Experiment III.

We also evaporated almost to dryness the nitric acid, which had boiled after the muriatic acid upon the platina. By the progress of the evaporation, this acid acquired a very deep red colour.

After having re-dissolved the residuum in water, to which it gave a brownish colour, there remained a powder likewise of a blackish brown colour; this powder, as it dried, assumed a very brilliant appearance; it seemed to be formed of small white points of a metallic lustre. Heated with the blow-pipe, it turned black without being fused; with borax, it was reduced into small metallic lamellæ which had the appearance of platina; the borax retained from it only a milky grey colour.

The liquor from which this substance was separated by evaporation, gave Prussian blue with the prussiate of potash; with gall-nuts a greenish precipitate, which was rendered purplish by the addition of prussiate of potash; with the green sulphate of iron, a black and heavy precipitate; its colour was not changed by sal ammoniac, nor did it give any precipitate.

The nitric acid, therefore, in boiling upon the platina, dissolved oxyde of iron, and another substance which has some analogies with platina, but which appears also to differ from it in several respects. Of this we shall speak hereafter.

Experiment IV.

The examination of the sulphuric acid which had boiled upon the platina, after the two preceding acids, afforded us only oxyde of iron, and some slight traces of titanium.

It is evident from the preceding experiments, that, though the platina had been cleaned as well as possible, there

there still remained in it a considerable quantity of different extraneous matters.

Experiment V.

Before proceeding to the solution of platina purified by the acids, and in order the better to judge of the effects which its solution would present to us, we wished to examine the foreign substances which had been mechanically separated from it.

For this purpose we fused a certain quantity of it reduced to powder with three parts of potash; the mass lixiviated afterwards with water, gave us a liquor of an orange-yellow colour, and there remained a brown powder which did not dissolve.

The solution, mixed with the nitric acid to saturation, assumed a fine red colour; in this state, it precipitated the solution of silver in the state of carmine red, the lead yellow, and the mercury cinnabar red.

These effects prove that the potash separated from the sand which accompanies the platina, a certain quantity of chromic acid; which, as shall immediately be seen, was combined in it with the oxyde of iron.

What the potash had not dissolved of the sand of platina was heated by the muriatic acid, which left only a small quantity of heavy matter, which we discovered to be platina.

The muriatic acid acquired by this combination a red colour, inclining to yellow; evaporated by a gentle heat, it collected into a gelatinous mass, which, being slightly dried and washed with water, remained without colour. The water had dissolved only muriate of iron.

The white matter, heated a-new with concentrated muriatic acid, yielded to it only a certain quantity of oxyde of titanium, which we recognized by the ordinary means;

means; what remained was only silver in an almost pure state.

There is, therefore, to be added to the substances which we have already indicated in platina, silex and chromate of iron; for it is evident that the chromic acid does not exist in it in a free state.

Experiment VI.

After having heated the 250 grammes of platina, as has been said above, with the three mineral acids, they were boiled in a mixture of 630 grammes of nitric acid, the specific weight of which was 1,304 and 570 grammes of muriatic acid, weighing 1,184, which makes about five times the weight of the platina.

When the acid appeared to dissolve nothing more, the solution was drawn off clear, the residuum was washed with water, and as there still remained some platina undissolved, it was boiled a-new, with as much nitro-muriatic acid as the first time; but notwithstanding an action of twelve hours, the whole was not dissolved; there still remained a small quantity of black matter, formed of small shining lamellæ.

Finally we put, for the third time, 600 grammes of nitro-muriatic acid upon this powder without being able to dissolve it; however the acid still assumed a brown colour, but of a slighter cast than that of the two first solutions.

The powder separated as mentioned above, when washed and dried, had a black colour, and was in the form of shining spiculæ, soft to the touch, blackening the fingers and paper like the carburet of iron; it weighed about five grammes, or a fiftieth of the platina employed.

Experiment VII.

We relinquished, for a moment, the examination of the solutions of platina, in order to occupy ourselves with the

the examination of this black powder, and endeavour to discover in it some properties which might serve us in the sequel, to explain the differences of colour of the solutions of platina, and those of the different precipitates which they give by the different re-agents. 1, Heated by itself with the blow-pipe, it is not fused, but it loses its black colour and assumes a white one, with a metallic reflection nearly similar to that of platina; 2, fused with borax, it is reduced into white and metallic laminæ; the salt retains only a milky grey colour from it; 3, fused with twice its weight of caustic potash, and afterwards lixiviated with water, it gave a yellow liquor inclining to a fallow colour, which passed into a red-brown by the addition of nitric acid, and which was then precipitated of a chesnut-red colour by the solution of silver, and a dull red by the solution of mercury.

It appears, according to these experiments, that the alkali separated from the black powder a certain quantity of chromic acid; but it also appears, that it had at the same time dissolved some substance, which produced a little alteration of its properties.

We afterwards poured upon the powder, which appeared to us blacker and more divided than before, a small quantity of muriatic acid, which extracted silex from it. Hence it appears, that there still remained in this powder a small quantity of chromate of iron, which the nitro-muriatic acid had not been able to dissolve; or else, that this substance exists in it in the metallic state combined with the new metal, which seems more probable, and which we hope to verify hereafter.

In the hope of attacking more easily this matter, already subjected to the action of the substances above-mentioned, we threw it into fused nitre. There were produced some slight scintillations of a red colour; but the

the powder was precipitated to the bottom with all its properties, and the nitre in part alkalized was not merely coloured by it; however, it contained a small quantity of matter, which the addition of nitric acid and heat separated from it.

Seeing that none of the substances employed could sensibly attack the black powder, we also treated it with three times its weight of caustic potash at a high degree of heat. The mass assumed this time, in cooling, a deep green colour, and the water with which we washed it received the same tinge; nevertheless, the powder did not appear to have been sensibly diminished in volume.

The alkaline liquor, saturated by the nitric acid, precipitated green flakes, which an excess of acid dissolved, keeping the same green colour to which it gave a reddish cast. By heat and evaporation, the same flakes were precipitated and became blackish; collected together and fused with borax, they were immediately reduced into metallic laminæ, and left in this salt a milky-grey colour; sometimes, however, they communicated to it, a slight green tinge.

The black matter having been very much divided by the different treatments which it has undergone, we thought it would then be more easily dissolved by the nitro-muriatic acid. We therefore boiled it for a considerable space at three different times with large quantities of this acid; and we actually obtained solutions of so deep a brown, that they appeared black, and yet the matter had not been entirely dissolved.

These solutions united together and evaporated, in order to expel from them a part of the superabundant acid, were subjected to the following experiments.

1. Four or five drops of this liquor, though containing very little matter, were sufficient to colour sensibly five or six ounces of water.

2. A small morsel of sulphate of iron caused it instantly to lose its brown colour, and to assume a green one *.

3. A thin plate of iron, with the aid of a gentle heat, gave it also at first a green colour, and precipitated from it black flakes, which gradually collected together in the form of a light lace.

4. Some drops of sal ammoniac poured into the solution, formed in it a very small precipitate of an extremely vivid purplish-red, and the supernatant liquor was of a bluish green colour; whereas the solution of pure platina gives a precipitate of a pale yellow colour with sal ammoniac.

5. Potash and the other alkalies formed in this liquor a flakey precipitate of a deep green colour; the prussiate of potash a deposit of a light green colour; the infusion of galls a greenish-brown one; hydro-sulpheret, one of a chesnut-brown colour.

6. Finally, some drops of this liquid put into a large quantity of solution of pure platina, gave it the property of forming a dark-red precipitate with sal ammoniac; whereas, by itself, it forms a pale-yellow precipitate with that salt.

Though we are still far from having discovered, by these experiments, all the properties of this substance; it appears to us, however, that it is a new and hitherto unknown metal; for none of those with which we are acquainted combines all the properties which we have found in it.

This metal constantly accompanies platina, and seems to serve it for its gangue, for there is none which does not present more or less abundant traces of it, and some spe-

* The solution of pure platina is not changed at all in its colour by the sulphate of iron

cimens

cimens contain it in large quantity, such as that which M. Proust has termed black platina.

We do not know whether, in nature, this substance is united with the platina: however, the form of laminæ or spiculæ, under which this metal remains after the solution of platina, and the difference of proportion in which it exists, in a solution of platina made at several times, seem to prove that it is only mixed with it.

Moreover, as we have still a large quantity of this substance remaining, and as the means of procuring it are very easy, we shall be able hereafter to subject it to a greater number of experiments, in order better to ascertain its properties, and to determine its specific characters with greater precision.

We know already that it does not combine with mercury, at least in the cold, whereas divided platina combines with it very readily; that it appears to be capable of uniting with platina, and of thereby receiving the property of more difficult solution in the nitro-muriatic acid.

Experiment VIII.

We now return to our solutions of platina in the nitro-muriatic acid. It will be recollected that we have three of them, produced from 250 grammes of platina, dissolved at three times.

The first, evaporated to the consistence of a syrup, in order to expel the superabundance of acid, crystallized in long compressed prisms of an extremely rich red-brown colour.

These crystals, re-dissolved in water, and mixed with a solution of sal ammoniac, gave a very abundant precipitate of a yellow colour inclining to an orange. The liquor which stood above the precipitate was of a more

decided red colour. This liquor was poured off, and the precipitate washed with distilled water, till the latter no longer presented any indication of the presence of iron by the re-agents. These different lixivia, united with the liquor first poured off, were put apart to be examined another time.

The second and the third solutions of the platina having a similar colour, were united, diluted with water, and precipitated by sal ammoniac. This last triple salt was of a very bright red colour, and its crystalline form was more marked than that of the first. The super-abundant liquor had also a much redder colour than that of the first precipitate.

These two precipitates having been well washed and dried, as we have said, we subjected them to comparative experiments, to endeavour to discover the cause of their so remarkable differences.

1. The red salt obtained from the last solution was less heavy than the yellow. This property appeared to us to depend upon its crystalline state.

2. It seemed to us to be sensibly more soluble in water than the yellow salt; which also explains very well why the mother-water of the yellow salt was redder than the salt itself, and why the latter lost its orange cast, and acquired a purer yellow by the lixiviations.

3. Fifteen grammes and twenty-nine centigrammes of the red salt were heated gradually to redness in a crucible of platina; there was disengaged, first, water; afterwards, muriatic acid, which appeared much concentrated and in part oxygenated; finally, muriate of ammoniac accompanied with muriatic acid. When no more vapours issued from the crucible, the platina was found reduced to a spongy mass of a grey colour, and very flexible in all its parts. The quantity of platina obtained

tained was six grammes, 59 centigrammes, which amounts to about $\frac{43}{100}$ of the red salt.

4. The same experiment was performed upon an equal quantity of yellow salt; the phenomena were similar, but the result was not altogether the same; the platina was a little whiter and less heavy; there were only 6 grammes 53 centigrammes of it, which amounts to $\frac{42}{100}$.

These proportions of the quantity of platina furnished by these two salts were constantly obtained in several repeated experiments. Thus it appears certain that the red salt contains a little more metal than the yellow.

5. Wishing to know whether the platina obtained from the two salts would comport itself in the same manner with the nitro-muriatic acid, and whether the solution of each would respectively yield precipitates coloured like those from which they had been produced, we dissolved each of these platinas in 5 parts of nitro-muriatic acid, composed like that of which we have spoken above, with this difference, that we mixed with it one fourth of water, in order that its action might be less strong upon the platina, and if possible none upon the foreign substances which might be united with it.

The platina of the yellow salt dissolved with the greatest facility in this quantity of acid, and it left only an inappreciable trace of a very light powder. The platina of the red salt likewise dissolved with facility and promptitude, but it left a much larger quantity of black powder, the total mass of which did not however amount to a decigramme. The solution of this platina was also much more coloured than the first.

We boiled at several times considerable quantities of nitro-muriatic acid upon the black powder afforded by the

the platina proceeding from the red salt, without being able completely to dissolve it.

Some experiments made upon this matter have proved to us that it was of the same nature with the black residuum which the raw platina leaves after its solution, with this difference, that the latter is less pure.

6. It was then requisite to determine how and of what colour the solutions of these two species of platina would be precipitated by sal ammoniac. For this purpose we first diluted them with the same quantity of water, and poured upon them solution of muriate of ammoniac till no more precipitate was formed. We saw with satisfaction that the solution of the platina produced from the red salt still gave a precipitate of a red colour, but a little less intense, and that that of the platina furnished by the yellow salt yielded also a yellow precipitate, but paler than the original salt of the same nature.

Hence we concluded, that the difference of colour which existed between these two salts depended upon an extraneous substance; and that this substance was the new metal of which we have spoken above.

7. It appeared to us equally interesting to inquire whether if we reduced anew, by means of heat, the precipitates of which we have been treating, they would still leave black powder in being dissolved in nitro-muriatic acid. What we had surmised on this subject proved to be the fact: the platina of the yellow precipitate dissolved this time in five parts of acid diluted with a fourth of water, without leaving any sensible residuum, and its solution was little coloured. But the platina of the red precipitate still left a black powder, less abundant indeed than the two first times; its solution also was less coloured, and the precipitate which it then yielded with

sal

Method of restoring essential Oils which have become rancid.

By J. B. De Roovas.

From Van Mons' Journal de Chimie, et de Physique.

In the course of my long and frequent operations upon essential oils, I have had occasion to discover a method of restoring these oils when they had become rancid, which appears to me very advantageous. The experiment which furnished me with it was the following:

I mixed with 16 ounces of oil of peppermint which was slightly rancid, one ounce of sulphuric ether; I left this mixture to digest for 24 hours, and I added five pints of spirit of peppermint. I filtrated the liquid, and distilled it in the balneum mariæ. I expected that almost the whole of the oil would have passed in the distillation together with the alcohol and the ether; but I was much surprized, when I opened the alembic, to find the greater part of the oil floating upon the residuous liquor. In order to ascertain the quantity of oil which had passed, I precipitated it from its solution in the alcohol, by means of water, according to my method. There was separated four and a half of oil, which was as transparent and colourless as water.

I then poured the residuum of the alembic, as well as the spirit and the water of precipitation, after having separated the oil from it, into an apparatus for distillation by the direct application of fire, and I distilled a second time. I had the satisfaction to see a spirit rise, from which the water, which passed at the same time, separated an oil as perfect as the preceding. I repeated this cohobation, pouring through the tube of the alembic, the mixture of spirit and water upon the residuous oil, till I had collected in all 12½ ounces of oil, as fragrant and as

free from rancidity as the most recent and best prepared oil of peppermint.

I rectified the spirit, and I judged, from some experiments, that it might be charged with a little more than an ounce and a half of oil.

What remained in the alembic was a thick gluey matter of the nature of turpentine. I boiled it with water, and I obtained a gross kind of boiled turpentine, perfectly similar to pitch-resin.

It would be difficult to say what influence the addition of the alcohol or of the ether had in the restoration, and in some sort the re-generation, of so large a quantity of essential oil, which had lost for the greater part its peculiar odour.

Formerly it would have been said, that the *spiritus rector*, with which the peppermint-alcohol is impregnated, had produced this effect; but now that we know that the odour of the essential oils does not depend upon a particular principle, but upon a peculiar constitution of the oily compound, we can no longer admit that the oil of the alcohol rendered odorus any portion of the disaromatised oil; and we must suppose that the ether or the alcohol were identified by decomposition with the substance of the oil.

In fact alcohol, and more particularly ether, contain precisely, for their principal part, hydrogen, which is the base of almost all odorus. Alcohol, ether, and the essential oils, are equally disposed to undergo a change in the proportional relations of their principles. There is, therefore, no objection against admitting this concurrence of a chemical operation, in the restoration which I obtained of the oil of peppermint.

Another circumstance comes in support of this explanation. I attributed, at first, to the different degree of the heat of the bath, and of that produced by the direct application

plication of fire, the oil which I obtained in the second operation, and when I applied the heat in the manner last-mentioned; but the oily products of the subsequent distillations, which were all made with the same heat, caused me no longer to hesitate in attributing the result to a successive re-action of the ether, or of the alcohol upon the hydrogenated oil.

A third circumstance in confirmation of this opinion is, that the quantity of alcohol appeared to me to be sensibly diminished, and that in the odour of the oil, which was perfectly pure, I did not discover the slightest trace of the odour of ether, which is so easy to be distinguised. It is true that, during the repeated cohobations, the ether might have flown off, as well as the portion of alcohol, which made the difference between the quantities of this liquid at the beginning and at the end.

However it still remains to be explained, how a principle of the alcohol, by assimilating itself with the principles of the oil, produces precisely that proportional compound which forms the species of oil upon which it reacts. To this it may at all events be answered, that the base of this oil is disposed to take only the principle, which shall restore it to the state of its original nature.

But even though this explanation were not founded in truth, and the influence of the ether and of the alcohol merely concurred to effect a separation in the parts of the oil from which its restoration resulted; it is, nevertheless, certain that hitherto no other means has succeeded in producing the same effect, and that my experiments afford a valuable method for restoring to commerce essential oils to an enormous amount, which have yearly been rejected as of no value.

P. S. Since I transcribed the above note, I have made a new experiment with an oil which ran thick like turpentine, and which no longer possessed the slightest odour, whereby

whereby the plant from which it had been extracted could be distinguished. I mixed four ounces of this oil with two drachms of sulphuric ether, and after four days I distilled with pure water. There passed two ounces and a half of an oil as clear and liquid as spirit of wine, having the most marked odour of wild thyme. There remained in the alembic two ounces of resinous matter of a brick colour.

Most certainly, in this operation, the ether developed the odour of the oil upon which it re-acted, or rather, it recomposed the oil by transmitting its hydrogenous principle to the oily base.

Intelligence relating to Arts, Manufactures, &c.

(Authentic Communications for this Department of our Work will be thankfully received.)

Method of giving Hemp and Flax the Appearance of Cotton.

M. GIOBERT, of Turin, improving upon Berthollet's process, has succeeded, after long experiments, undertaken on a very large scale, to give hemp and flax the exact appearance of cotton. A great number of pieces of cotton-like stuff, made at his manufactory, have been sold without being distinguished from ordinary cotton. The operations which he employs are the following.

1. *Preliminary steeping of the Tow.*

The tow is steeped in old ley, or, if this cannot be procured, in water in which mucilaginous plants have been boiled, and to which must be added a small quantity of potash. In summer the maceration is continued five days, and in winter is prolonged to seven days.

2. *Of Leys and Immersions in Oxygenated Muriatic Acid.*

Immerse the tow four times alternately in diluted caustic ley and in oxygenated muriatic acid. The ley must be

be free from lime, and the time of each immersion in the boiling liquid should not exceed three hours. The ley is then drawn off, and the tow is placed in heaps, covered with a cloth, and pressed by a heavy weight.

3. *Acid-bath.*

The acid-bath is indispensible to give the tow a brilliant white colour.

The tow after being well washed is passed through a bath of muriatic acid, charged with one-fiftieth of acid, and is left there about half an hour. M. Giobert prefers muriatic acid to sulphuric acid, which is generally used for this purpose, on account of the sulphate which the last-mentioned acid forms with the lime in the tow, which, being insoluble, attaches itself to the tow, and renders it rough.

4. *Soaping.*

The tow, while quite impregnated with the acid, is removed into hot spontaneous liquor.

By this operation the tow not only acquires the highest degree of whiteness, but the oil, separated from the potash, attaches itself to the tow, and gives it softness and flexibility.

5. *To give Flexibility to the Cotton of Hemp.*

The tow is made into large parcels, and exposed for three months in a damp situation. A kind of fermentation takes place, which gives it all the flexibility that is desired.

6. *To give to the Cotton of Hemp all the Appearances of ordinary Cotton.*

Hemp treated as above always preserves a lustre by which it may be distinguished from real cotton, which is dull. To correct this, mix with the cotton of hemp from 10 to 15 *per cent.* of ordinary cotton.

List

List of Patents for Inventions, &c.

(Continued from Page 160.)

JOHN HEPPENSTALL, of Doncaster, in the county of York, Machine-maker and Engineer; for improvements in machinery or mill-spinning, for the spinning of cotton, wool, silk, hemp, flax, substitutes for hemp and flax, and for the laying or twisting cord, linen, line, twine, and thread. Dated June 2, 1804.

THOMAS JOHNSON, late of Bredbury, but now of Stockport, in the county palatine of Chester, Weaver; for a further addition and improvement to a new and improved method applicable to the dressing of cotton-warp, and also a new and improved method if and when the same shall be used for dressing linen, silk or woollen warps. Dated June 2, 1804.

ARTHUR WOOLF, of Wood-street, Spa Fields, in the County of Middlesex, Engineer; for improvements in the construction of steam-engines. Dated June 7, 1804.

TIMOTHY BENTLEY, of Lockwood, in the parish of Almondbury, in the county of York, Common Brewer; for a method of seasoning new casks, and purifying musty ones, in a style far superior to any other. Dated June 19, 1804.

LYON PYKE, of No. 8, Colchester-street, Whitechapel, in the county of Middlesex, Pencil-maker; for improvements on pencils, which he intends to denominate "*Pyke's Patent improved Pencils.*" Dated June 20, 1804.

EDWARD MARTIN, of Morriston, in the county of Glamorgan, Gentleman; for a method of making pig and cast iron, of every description, from iron-stone, iron-mine, and iron-ore, and of remelting, preparing, and refining of pig and cast iron of every sort, and for the making of such pig and cast iron into wrought or bar iron, by using raw stone, coal, and culm, to be worked and made by blast. Dated June 20, 1804.

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Vicar of Hurley in Berkshire, Chaplain to the Earl of Moira, Author of the British Nepos, &c. &c.

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